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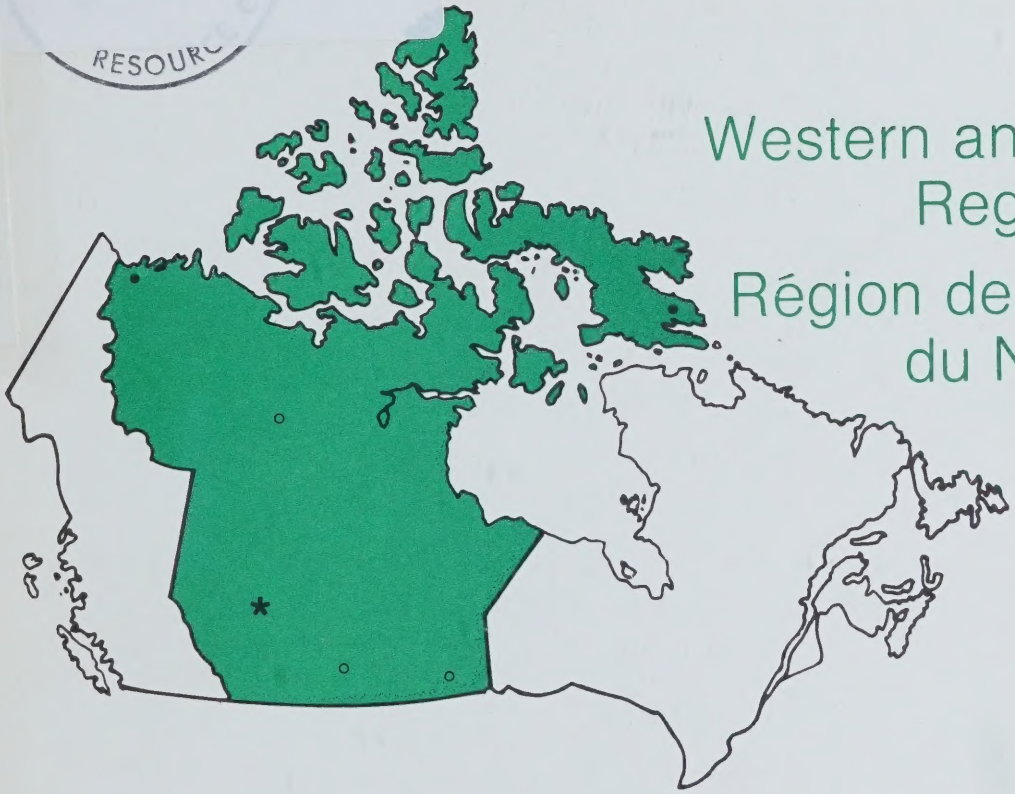

# Western and Northern Region

# Région de l'Ouest et du Nord

ENVIRONMENTAL ASSESSMENT
OF DREDGING TECHNOLOGIES

by

D.J. Thomas, L.C. Martin
and J.P. Ruffell

W&NR-86/87-CP(EP)-IC

Environmental
Protection Service

Service de la protection
de l'environnement

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Prepared by:

Arctic Laboratories Limited
ESL Environmental Sciences Limited
EBA Engineering Consultants Ltd. in
association with Tekmarine Inc.

for:

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## ABSTRACT

This report provides an overview of the state of the art of dredging technology, outlines procedures and strategies available for mitigation of environmental effects associated with dredging, provides an evaluation of the effectiveness of available mitigative measures, and describes the size and activities of the world dredging fleet. It is concluded that since Beaufort Sea sediments are primarily uncontaminated the most effective mitigative measure which can be applied is the avoidance of sensitive areas and implementation of timing restrictions. Also, additional effort in compiling information on the environmental effects of dredging and dredge spoil disposal operations in the Canadian Beaufort Sea does not appear to be warranted at the present time. The information contained in this report will also be useful to project proponents, dredging contactors and regulators in other parts of Canada.



## RÉSUMÉ

Ce rapport présente un aperçu des techniques de pointe dans le domaine du dragage ainsi que des mesures et des stratégies qui permettent d'atténuer les répercussions négatives du dragage sur l'environment. On y fait aussi l'évaluation de l'efficacité des mesures d'atténuation des effets négatifs du dragage et décrit la taille et les activités de la flotte de dragues à l'échelle mondiale. Puisque les sédiments dans la mer de Beaufort sont à toutes fins utiles non contaminés, il est établi que la meilleure façon de réduire les répercussions négatives des travaux de dragage consiste à éviter les endroits vulnérables et à imposer des restrictions sur les périodes de dragage permises. En outre, il ne semble pas justifié, à l'heure actuelle, de compiler d'autres données sur les répercussions des activités de dragage et d'immersion des matériaux de dragage dans les eaux Canadiennes de la mer de Beaufort. Les données présentées dans ce rapport seront également utiles aux promoteurs de projets, aux entreprises de dragage et aux organismes de réglementation ailleurs au Canada.

The correct citation for this report is:

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## SUMMARY

This report provides an overview of the state-of-the-art of dredging technology, outlines procedures or strategies available for mitigation of environmental effects associated with dredging, provides an evaluation of the effectiveness of mitigative measures available to prevent or reduce environmental impact associated with dredging operations and describes the size and activities of the world dredging fleet. In addition, the report provides a review of the available information on dredging and environmental effects associated with dredging in the Beaufort Sea and other areas of the world where significant dredging operations are undertaken. Where possible, dredging operations specially associated with oil and gas exploration development and production have been identified. Emphasis throughout the report has been placed on mitigative technologies, particularly on recently developed procedures such as capping which are expected to be of potential use in the successful isolation of contaminated dredged materials from the overlying marine ecosystem at open water disposal sites.

The environmental effects of dredging and dredge spoil disposal are presented in the categories of detrimental, incidental and beneficial effects and include: (1) adverse effects associated with dredging operations at the dredging site; (2) adverse effects associated with the disposal of dredged materials in open water; (3) beneficial effects associated with operations at the dredging and disposal sites; and (4) incidental beneficial effects associated with dredging operations at the dredging sites. It is clear that environmental effects are certain to occur during and after dredging and dredge spoil disposal operations in aquatic environments. The effects will be strongly related to the scale and duration of the operation and the chemical characteristics of the substrate. Most of the effects of dredging operations are related primarily to two factors (1) the resuspension of sediment particles; and (2) excavation of substrate and increased sedimentation near the dredging operation and disposal site. In general, the greatest potential for environmental effects is associated with the dredging and disposal of contaminated sediments, although serious detrimental effect can also be associated with the dredging and disposal of uncontaminated sediments if the dredging operations occur in sensitive biological habitats (such as spawning and rearing areas, and migration corridors).

Mitigative techniques available to reduce the environmental effects of dredging for coastal marine/estuarine, offshore marine and freshwater environments are presented with emphasis on turbidity, sedimentation and fish entrainment effects. Mitigative techniques available to reduce the turbidity produced by dredging include selection of dredge type and specialised dredge equipment, operation of the dredge, application of chemical coagulants, use of silt curtains, below surface disposal of dredge spoil and timing restrictions on the dredging activities. Sedimentation effects can be mitigated by choosing the most appropriate disposal alternative and disposal site; using capping procedures when contaminated sediments are involved; using a submerged diffuser; and by imposing timing restrictions on the dredging activities. Finally, entrainment of fish by dredge-produced suction currents can be reduced by timing and area restrictions on dredging activities. Information on the effectiveness and technological aspects of some of the state-of-the-art in mitigative strategies, however, is limited by the reluctance of the dredging industry to divulge details of what is considered a saleable commodity which forms an important part of their competitive edge in offering dredging services.

The main conclusions and recommendations of this study are:

1. Additional effort in compiling information on the environmental effects of dredging and dredge spoil disposal operations in the Canadian Beaufort Sea does not appear to be warranted at the present time. Sufficient information and experience are currently available from other parts of Canada and other countries to indicate that, with the exception of areas of special sensitivity, consequential environmental effects associated with the dredging and disposal of uncontaminated dredge spoils are highly unlikely. The dredging and disposal of contaminated sediments, on the other hand, are areas of considerable environmental concern. At the present time, however, it should be sufficient for the regulatory agencies in Canada to monitor the progress of other countries, such as the United States and Japan, in dealing with the existing dredging and disposal of contaminated sediments in aquatic environments. In the event that Beaufort Sea sediments become contaminated in the future and that dredging and disposal of these sediments becomes necessary, the most up-to-date technology and techniques could then be applied to the problem.

2. Although mitigative technologies exist for offshore dredging and disposal operations, they have been built on a small scale and project-specific basis. In general, most of these technologies such as silt curtains and chemical coagulants are infeasible in the Beaufort Sea. Furthermore, they are unnecessary at the present time. The approaches to mitigation most applicable to the Beaufort Sea are operational ones such as controlling cutter speed and movement to limit turbidity generation during dredging and the imposition of timing or area restrictions to reduce the habitat disturbances at sensitive times or locations.

3. Selection of dredge excavation and disposal sites should be conducted in a manner which avoids sensitive marine habitats and uses. This operational approach has been used in many regions as a mitigative strategy to avoid or minimize adverse environmental effects. The assessment of specific applications for dredging permits could be assisted by the availability of a map series that delineates potential dredge excavation and disposal sites and describes their relative environmental sensitivity. These maps should place greatest priority on areas identified by industry as having the highest potential for future dredging operations and should identify environmental sensitivity in terms of the habitat and populations of all trophic levels. Dredging sites in the nearshore zone should be emphasized during the sensitivity mapping because of: (1) the potential for very shallow nearshore alterations in seafloor contours to locally change water circulation patterns and the Temperature/Salinity (T/S) characteristics of the water column; and (2) the expected importance of inshore areas as feeding, rearing and in some species, overwintering habitat for several anadromous species of fishes. In addition, this nearshore zone is an important migration corridor for fish at some times of the year.

The recommended sensitivity maps should use information contained in the Department of Fisheries and Oceans Arctic Data Compilation and Appraisal Series to the extent possible, as well as data collected during past and ongoing studies by or on behalf of all government agencies and petroleum industry operators in the Beaufort region. The utility of the maps should also be maximized through a periodic updating process as new environmental information becomes available or changes in the development scenario for

the region suggest that other sites of dredging or spoil deposition may be necessary. It is also emphasized that information contained in the recommended sensitivity map series may be of substantial value for other purposes unrelated to dredging, including the identification of areas requiring priority protection/cleanup in the event of oil spills in the region.

4. Effort should be directed at expanding the definition of "contaminated" sediment to include substances in addition to Hg, Cd, PCBs and "oil and grease". Ideally, the concentrations used as criteria for "contaminated" should bear some relationship to biological availability and biological effect.

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## 1. INTRODUCTION

This report provides an overview of the state-of-the-art of dredging technology, outlines procedures or strategies available for mitigation of environmental effects associated with dredging, evaluates the effectiveness of mitigative measures available to prevent or reduce environmental impact associated with dredging operations, and describes the size and activities of the world dredging fleet. In addition, the report provides a review of the available information on dredging and environmental effects associated with dredging in the Beaufort Sea and other areas of the world where significant dredging operations are undertaken. Where possible, dredging operations specially associated with oil and gas exploration, development and production have been identified.

Emphasis throughout the report has been placed on mitigative technologies, particularly on recently developed procedures such as capping which are expected to be of potential use in the successful isolation of contaminated dredged materials from the overlying marine ecosystem at open water disposal sites. Only brief descriptions of the environmental effects of dredging and dredged material disposal are provided in this report since this subject has been treated in detail in other recent reviews and the general scientific literature.

Much of the information contained in this report is based on research conducted by the U.S. Army Corps of Engineers. The Corps is unquestionably the leading authority on the state-of-the-art of most dredging-related technological and environmental issues in the world today. The primary sources of information used during preparation of this review and assessment included:

(1) published reports of the Waterways Experiment Station of the U.S. Army Corps of Engineers;

(2) recent proceedings of specialty conferences on dredging (e.g., Dredging '84; Fifth International Ocean Disposal Symposium, Sept. 1984; World Dredging Congresses);

(3) material obtained during a site visit to the Waterways Experiment Station, Vicksburg, Mississippi, U.S.A.;

(4) a site visit to various dredging operators in Japan; and

(5) interviews with scientists and engineers working for dredging companies, government agencies and international bodies.

Contacts used during preparation of this report are listed in Appendix B.

This project was co-ordinated by Arctic Laboratories Limited with contributions from ESL Envirionmental Sciences Limited and EBA Engineering Consultants Ltd. Funding for the project was provided by the interdepartmental Panel on Energy Research and Development (PERD). The report outlines the findings of the contractors and does not necessarily represent the policy of the Environmental Protection Service, Environment Canada.

## 2. WORLDWIDE DREDGING OPERATIONS

### 2.1 The Global Dredging Fleet

The global dredging fleet today is in a period of stagnation following a period of sustained growth during the 1970's. Although gross tonnage is constant at 1970's levels, utilization remains low. Large fleets of vessels, designed and constructed for the boom in Middle East construction, remain mothballed in that region, awaiting new markets.

Three major dredging nations, the Netherlands, Japan and especially Korea, made large increases in their fleets during this period of expansion. The slow-down in the region affected all nations; however, it provided incentive for Japan to compete for the high technology sector of the market, a sector traditionally dominated by the Dutch.

This entry of the Japanese into the field of high technology works is significant to Arctic operations. Although the Japanese have not worked in the region, they remain the most likely competition for the Dutch fleet at present in the area.

#### 2.1.1 The Nature of the Fleet

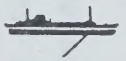
The number and type of ships in the global dredging fleet responds slowly to areas of opportunity. The abundance of cutter-suction dredges available today is in direct response to the Middle East construction boom of the 1970's. The present trend towards increased maintenance dredging activity is requiring increased refitting and some new building of equipment for these purposes. A summary of the world dredging fleet by dredge type and country is given in Table 1. Specific details about each vessel for each country are provided in Appendix A. A summary of the world hopper, suction and mechanical dredge fleets is shown in Tables 2, 3 and 4 respectively.

The fleet of dredging plants that may be available for artificial island construction in arctic waters can be classified on the basis of their operational characteristics for the purposes of this study. A tabulation of dredges presently active in the region appears as Table 5. Both the type of equipment and the operating technique used are important as both will influence the potential of dredges for causing sediment resuspension.

# TABLE 1.

## SUMMARY OF WORLD DREDGING FLEET

(Adapted from: World Dredging and Marine Construction Magazine, March 1984)

| Country | TYPE OF DREDGE | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Suction Systems | | | | | Bucket Systems | | | | | Special | | |
| |  Trailing Suction Hopper (TH) | Suction Hopper (SH) | Cutter Suction (CS) | Suction (S) | Suction Dustpan (SD) | Bucket Ladder (BL) | Floating Grab Clamshell (BG/BC) | Bucket Dipper (BD) | Grab Hopper (GH) | Bucket Backhoe (BB) | Wheel Systems (BWS) | Mining (M) | Total |
| Albania | | | | | | | 1 BG | | | | | | 1 |
| Argentina | 13 | | 9 | 3 | | | | | | | | | 25 |
| Australia | 5 | 1 | 26<br>3 CS/M | 13 | | 3<br>2 BL/M | 9 BG<br>1 BG/BC | | | | | | 63 |
| Bahamas | | | | | | | 1 BG | | | | | | 1 |
| Bangladesh | | 1 | 2 | | | | | | 1 | | | | 4 |
| Belgium | 19 | 1 | 30 | 5 | | 5 | | | | 2 | | | 62 |
| Bolivia | | | | | | 3 BL/M | | 1 | | 1 BB/M | | | 5 |
| Brazil | 5 | | 37 | 2<br>3 S/M | | 2<br>7 BL/M | 1 BG | | | | 1 BWS/M | | 58 |
| Burma | 1 | | | | | | 2 BG | | | | | | 3 |
| Canada | 5 | 3 | 37 | 6 | | | 44 BG<br>1 BG/BD<br>5 BC/BD | 3 | 1<br>3 BB/BG<br>1 BB/BC | 5 | | | 113 |
| Chile | | 1 | | | | | | | 1 | | | | 2 |
| China | 14 | | | | | | | | | | | | 14 |
| Columbia | | 1 | 22 | | | 6 BL/M | | | | | | | 29 |
| Cuba | | | 1 | | | | | | | | | | 1 |
| Czechoslovakia | | | 1 | 2 | | | 3BG<br>4 BC/M | | | | | | 10 |
| Denmark | 10 | 16 | 1 | 14 | | 2 | 1 BG | | 1 | 1 | | | 46 |
| Ecuador | | | 6 | | | | | | | | | | 6 |
| Egypt | | | 4 | | | | | | | | | 2 BS | 6 |
| Finland | | | 19 | 3 | | 3 | 4 BG | 1 | | 15<br>1 BB/BG | | | 46 |
| France | 10 | 5 | 24 | 7 | | 11 | 5 BG | 1 | 2 | 4 | | | 69 |
| French West Indies | | | 1 | | | | 1 BG | | | | | | 2 |

## TABLE 1.

## SUMMARY OF WORLD DREDGING FLEET (cont'd.)

(Adapted from: World Dredging and Marine Construction Magazine, March 1984)

| Country | TYPE OF DREDGE | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Suction Systems | | | | | Bucket Systems | | | | | Special | | |
| | Trailing Suction Hopper (TH) | Suction Hopper (SH) | Cutter Suction (CS) | Suction (S) | Suction Dustpan (SD) | Bucket Ladder (BL) | Floating Grab Clamshell (BG/BC) | Bucket Dipper (BD) | Grab Hopper (GH) | Bucket Backhoe (BB) | Wheel Systems (BWS) | Mining (M) | Total |
| Gambia | | | | | | | | | 1 | | | | 1 |
| East Germany | | | | | | | 3 BG | | | | | | 3 |
| West Germany | 8 | | 22 | 1 | 1 | 11 | 5 BG | | | 1 | | | 49 |
| Ghana | | | | | | 3 BL/M | | | | | | | 3 |
| Greece | 1 | | 5 | | | | 13 BG | | | | | 1 DD | 20 |
| Greenland | | | | 1 | | | | | | | | | 1 |
| Republic of Guinea | 1 | 1 | | | | | 1 BG | | | | | | 3 |
| Guyana | | | | | | | | | | 1 | | | 1 |
| Honduras | | | 1 | | | | | | | | | | 1 |
| Hong Kong | | | 4 | 1 | | | 1 BC<br>11 BG/BC | | 1 | | | | 18 |
| Iceland | | 2 | 1 | 1 | | | | | | 1 | | | 5 |
| India | 19 | 4 | 9 | | | | 1 BG | | 5 | | | | 38 |
| Indonesia | 1 | | 25 | 2 | | 31 BL/M | 2 BG | | | | | | 61 |
| Iraq | 5 | 3 | 4 | | | | 1 BG | | | | | | 13 |
| Ireland | | 1 | 1 | | | 1 | 5 BG<br>1 BG/S | | 1 | | | | 10 |
| Italy | 4 | 1 | 11 | 1 | 1 | 4 | 3 BG | 1 | | | | | 26 |
| Jamaica | | | 2 | | | | | | | | | | 2 |
| Japan | 5 | | 88 | 12 | | 1 | 23BG | 6 | | | | | 135 |
| Kenya | | | 1 | | | | | | | | | | 1 |
| Korea | | | 12 | | | | 15 BG | | | | | | 27 |
| Kuwait | | | 2 | | | | | 1 | | | | | 3 |
| Libya | | | 1 | | | | 1 BG | | | | | | 2 |
| Malaysia | | 2 | | | | 2<br>54 BL/M | | | 2 | | 1 | | 61 |
| Mexico | 9<br>1 TH/CS | | 30<br>1 CS/TH | | | | | | | | | | 41 |

## TABLE 1.

## SUMMARY OF WORLD DREDGING FLEET (cont'd.)

(Adapted from: World Dredging and Marine Construction Magazine, March 1984)

| Country | TYPE OF DREDGE | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Suction Systems | | | | | Bucket Systems | | | | | Special | | |
| | Trailing Suction Hopper (TH) | Suction Hopper (SH) | Cutter Suction (CS) | Suction (S) | Suction Dustpan (SD) | Bucket Ladder (BL) | Floating Grab Clamshell (BG/BC) | Bucket Dipper (BD) | Grab Hopper (GH) | Bucket Backhoe (BB) | Wheel Systems (BWS) | Mining (M) | Total |
| Morocco | 4 | 1 | | | | 1 | | | | | | | 6 |
| Mozambique | 2<br>4 TH/CS | 1 | | | | | 2 BG/BC | | | | | | 9 |
| Netherlands | 70 | 9 | 107<br>2 CS/S | 64 | | 41<br>1 BL/M | 27 BG<br>3 BG/BC | | 1 | 15 | 6 | | 346 |
| Netherlands Antilles | 3 | | | | | | | | 3 | | | | 6 |
| New Zealand | 1<br>3 TH/BG | | 8 | | | 2 | 2 BG | | 3 | | | | 19 |
| Nigeria | 1 | | | | | | | | | | | | 1 |
| Norway | | | 2 | 1<br>2 S/M | | | 11 BG | 2 | | 2 | | 1 GS | 21 |
| Pakistan | 1 | | 2 | | | 2 | 1 BG | | | | | | 6 |
| Panama | | | 2 | | | | 1 BG | 2 | | | | | 5 |
| Peru | | 1<br>1 SH/CS | | | | | | | | | | | 2 |
| Philippines | 2 | | 19 | 2 | 3 | 2<br>1 BL/M | 1 BG | | | | | 3 C/BC | 33 |
| Poland | 1 | | | | | | | | | | | | 1 |
| Portugal | 2 | 1 | 4 | 1 | | 6 | 5 BG | | 2 | | | | 21 |
| Romania | | 5 | | | | | 4 BG | | | | | | 9 |
| Singapore | 1 | | 11 | | | | 1 BG<br>14 BG/BC | | | | | | 27 |
| South Africa | | 2<br>4 SH/TH | | | | 1 | | | 1<br>1 GH/SH | | | | 9 |
| Spain | | | | 1 | | | | | | | | | 1 |
| Sri Lanka | 1 | 1 | | | | | | | 1 | | | | 3 |
| Sweden | 1 | 1 | 6 | 2 | | 4 | 4 BG | | | 3 | | | 21 |
| Taiwan | 1 | | 9 | | | | | | | | | | 10 |
| Thailand | 6 | | 6 | 1 S/M | | 1<br>8 BL/M | 2 BG/BC | | | | | | 24 |

# TABLE 1.

## SUMMARY OF WORLD DREDGING FLEET (cont'd.)

(Adapted from: World Dredging and Marine Construction Magazine, March 1984)

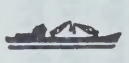
| Country | TYPE OF DREDGE | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Suction Systems | | | | | Bucket Systems | | | | | Special | | |
| | Trailing Suction Hopper (TH) | Suction Hopper (SH) | Cutter Suction (CS) | Suction (S) | Suction Dustpan (SD) | Bucket Ladder (BL) | Floating Grab Clamshell (BG/BC) | Bucket Dipper (BD) |  Grab Hopper (GH) | Bucket Backhoe (BB) | Wheel Systems (BWS) | Mining (M) | Total |
| Trinidad | 1 TH/GH | | 1 | | | | | | | | | 1 B | 3 |
| Turkey | | | 1 | | | 6 | 6 BG | | | | | 1 HS | 14 |
| United Arab Emirates | | | 6 | | | | | | | | | | 6 |
| United Kingdom | 45 | 23 | 10 | 5 | | | 21 BG<br>1 BC/BG | | 22 | 8 | | 2 B | 137 |
| U.S.A. | 20 | 1<br>4 SH/M | 240<br>48 CS/M | 23<br>38 S/M | 4 | 8 BL/M | 150 BG<br>8 BG/BC<br>15 BC/BG | 11 | 1 | 9 | | 1 C<br>2 BS<br>1 BS/M<br>3 TS/M<br>2 Auger | 589 |
| Uruguay | 1 | | 1 | | | 1 | | | | | | | 3 |
| U.S.S.R | 12<br>1 TH/SH | 7 | 1 | | | 4 | 14 BG | | 1 | | | 1 HB | 41 |
| Venezuela | 3 | | 8 | | | | | | | | | | 11 |
| Vietnam | 2 | | | | | | | | | | | | 2 |
| West Indies | | | 3 | | | | | | | | | 2 B | 5 |
| Yugoslavia | 6 | 5 | 13 | 7 | | 1 | 1 BG/BC | | | | | 7 B | 40 |
| TOTALS | 330 | 105 | 953 | 224 | 9 | 241 | 463 | 31 | 56 | 69 | 8 | 30 | 2522 |

**Table 2.**
**World Hopper Dredge Fleet**

| Hopper Capacity ($m^3$) | Dredge Type: Trailing Suction Hopper | Dredge Type: Suction Hopper | Dredge Type: Grab Hopper |
|---|---|---|---|
| <1,000 | 82 | 42 | 23 |
| 1,000 to 3,000 | 127 | 17 | 2 |
| 3,000 to 6,000 | 52 | 5 | 2 |
| 6,000 to 10,000 | 22 | - | - |
| >10,000 | 2 | - | - |
| Unknown | 44 | 41 | 31 |
| **Total** | **330** | **105** | **56** |

**Table 3.**

**World Suction Dredge Fleet**

| Intake Pipe Size (cm) | Horsepower | Dredge Type: Cutter Suction | Dredge Type: Suction |
|---|---|---|---|
| < 30 cm | < 500 | 92 | 38 |
| | > 500 | 65 | 16 |
| | < 500 | 3 | 2 |
| 30 - 50 cm | 500 - 1,000 | 96 | 12 |
| | > 1,000 | 88 | 8 |
| | < 1,000 | - | 2 |
| 50 - 75 cm | 1,000 - 5,000 | 217 | 31 |
| | > 5,000 | 56 | 5 |
| | < 5,000 | 8 | 2 |
| > 75 cm | 5,000-10,000 | 46 | 8 |
| | > 10,000 | 48 | - |
| Unknown | | 234 | 100 |
| **Totals** | | **953** | **224** |

Note: Totals in Tables 1 and 3 do not agree because intake pipe size and horsepower are not given for all dredges reported in Table 1.

**Table 4.**

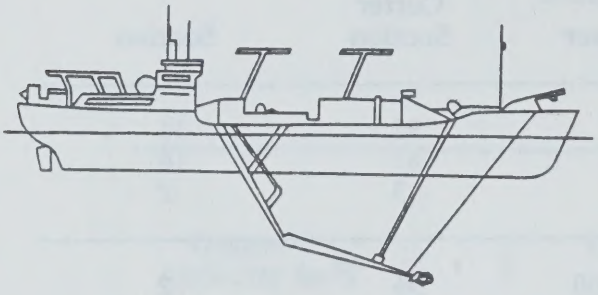
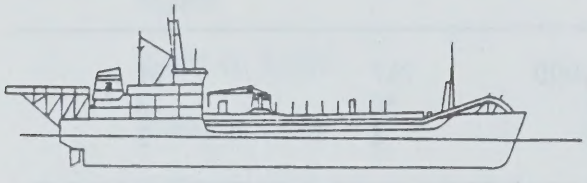
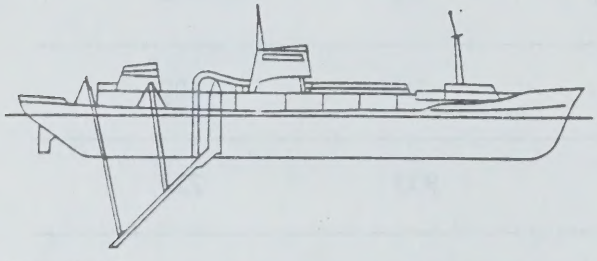
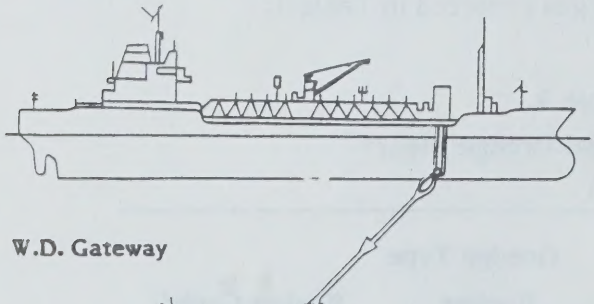
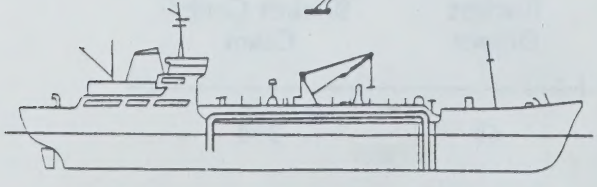
**World Mechanical Dredge Fleet***

| | Dredge Type: Bucket Ladder Wheel | Bucket Dipper | Bucket Grab/ Clam |
|---|---|---|---|
| No. of Dredges | 218 | 64 | 334 |

*Note: Most of the mechanical dredges are used for mining operations and harbour construction repair work.

Table 5.

Dredges Presently Active in the Canadian Beaufort Sea

| Vessel | Specifications |
|---|---|
| **Beaver Mackenzie**  | Type: Suction (1939)<br>Owner: Royal Boskalis Westminster N.V. (Beaver Dredging Ltd.)<br>Size: 91m x 14m, 4.4m draught<br>Capacity: Beaver Mackenzie is configured as a stationary suction or cutter suction dredge and, as such, has no storage<br>Intake Size: 850 mm<br>Dredge Depth: Up to 45 m<br>Comments: Arctic service for 10 years; has been converted to cutter suction for several projects |
| **Cornelius Zanen**  | Type: Trailing Suction Hopper (1982)<br>Owner: Zanen-Verstoep N.V. (Zanen Offshore and Marine Services Ltd.)<br>Size: 120m x 23 m, 8.0m draught<br>Capacity: 8,000 $m^3$<br>Power: 15,025 hp<br>Dredging Depth: 32m, optional 50m<br>Sailing Speed: 15.5 knots<br>Comments: Ice class BV 1A |
| **Geopotes IX**  | Type: Trailing Suction Hopper (1967)<br>Owner: Volker-Stevin Dredging B.V. (Volker-Stevin Dredging (Canada) Ltd.)<br>Size: 128m x 21m, 10m draught<br>Capacity: 6,400 $m^3$<br>Power: 10,801 hp<br>Dredging Depth: 30m<br>Sailing Speed: 12 knots<br>Comments: Modified to allow clay stripping and dumping |
| **Geopotes X**  | Type: Trailing Suction Hopper (1970)<br>Owner: Volker-Stevin Dredging B.V. (Volker-Stevin Dredging (Canada) Ltd.)<br>Size: 135 m x 22m, 12.95m draught<br>Capacity: 9,074 $m^3$<br>Power: 19,032 hp<br>Dredging Depth: 35m<br>Sailing Speed: 16 knots<br>Comments: Large hopper, highly efficient |
| **W.D. Gateway**  | Type: Trailing Suction Hopper (1969)<br>Owner: Royal Boskalis Westminster N.V. (Beaver Dredging Ltd.)<br>Size: 129 m x 20m, 8.7m draught<br>Capacity: 7,000$m^3$<br>Sailing Speed: 16 knots |

2.1.1.1 Hydraulic Dredges

Hydraulic or suction dredges feature the use of vacuum pumps to lift disturbed sediments mechanically. Depending on the design, these sediments are deposited in large hoppers in the ship for later discharge, or are funnelled directly into a pipeline for discharge at an outwash site. Hydraulic dredges can remove a large amount of sediment in a short period of time and deposit this sediment precisely at a site distant from the source.

There are a variety of hydraulic dredges in use. In the Arctic, however, two specific types have been used: the stationary suction dredge and the trailing suction hopper dredge. Although the former was active in the early stages of arctic development, the latter has become prevalent in arctic waters today. Their abundance can be attributed to three factors: (1) the large distances between borrow sources and island sites in the region; (2) their ability to work in floating ice; and (3) their ability to be used in diverse construction activities (e.g., subcutting, filling, levelling).

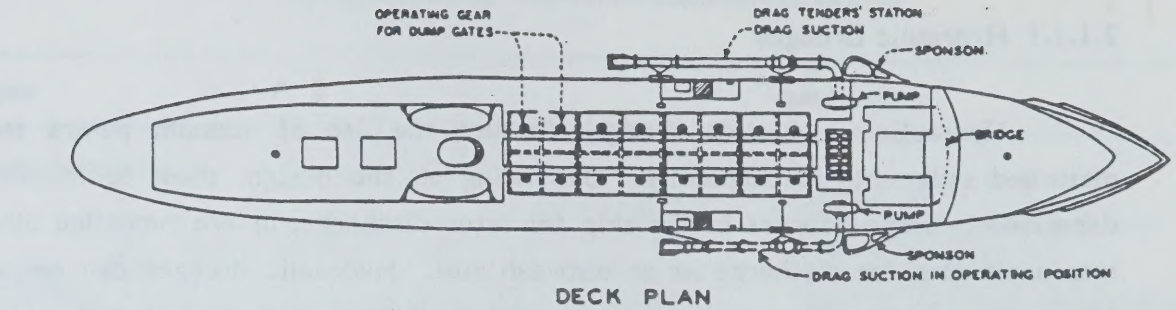
The major feature of the hopper suction dredge (Figure 1A) is the draghead which, as the vessel moves forward, collects the bottom sediment hydraulically through the dragarm, storing the sediment temporarily in on-board hoppers. Most modern dredges are equipped with two dragarms mounted on the sides of the vessel and have hopper capacities up to 9000 cubic metres.

The process of filling of the hoppers is often continued after the hoppers have been completely filled in order to maximize the soil/water ratio in the vessel. This process, known as overflow, will also enhance the quality of fill collected as it will selectively remove fine materials which would be undesirable in construction activities.

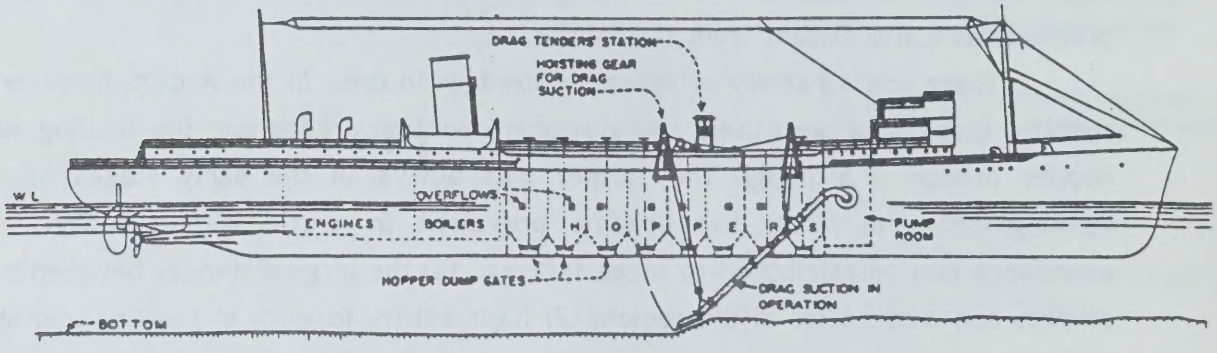
Dumping of the material takes place either through hydraulically operated bottom doors or through a controlled pump-out system. This pump-out would generally take place via a floating pipeline to a "dumpbarge" equipped with a discharge chute for artificial island construction.

2.1.1.2 Cutter Suction Dredges

The cutter suction dredge (Figure 1A) was developed to excavate the harder sediments that a simple suction dredge could not remove. It is not self-propelled, but




DECK PLAN




OUTBOARD PROFILE

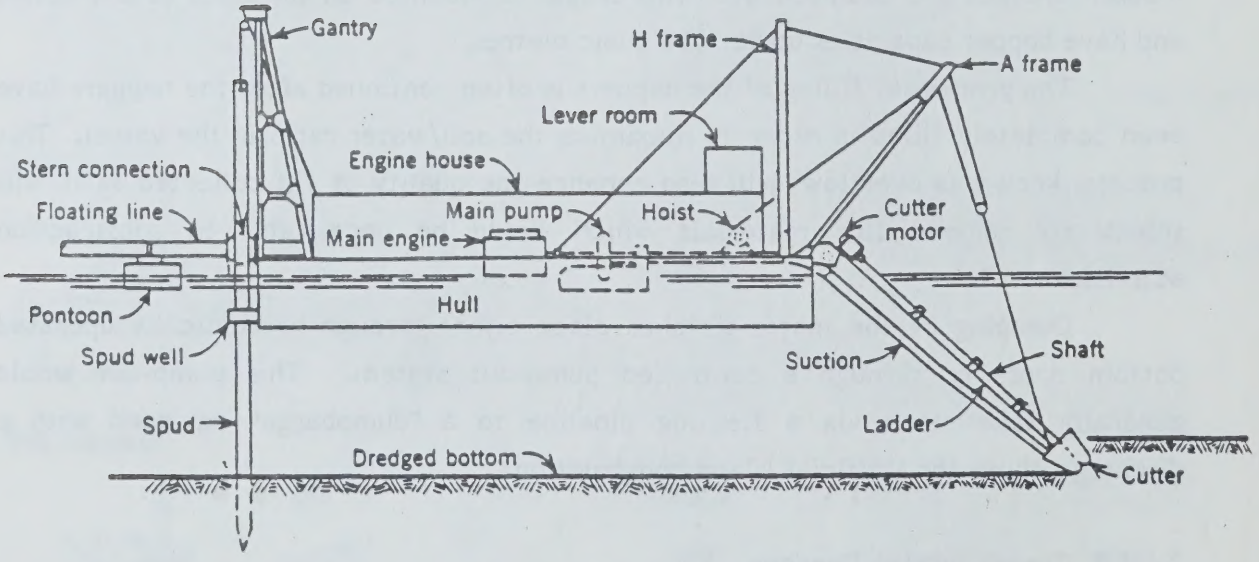



**Figure 1A.** Diagrams of suction hopper dredge (top) and cutter suction dredge (bottom).

moves using spuds and anchor wires. It disturbs the sediment using an extended adjustable arm (ladder) equipped with a rotating cutterhead. The sediments are then drawn into a suction head set back from the cutter from where they are forced, using a series of centrifugal pumps, into a pipeline to the discharge point. These dredges are rated on the diameter of the inlet pipe and the installed power of the cutterhead.

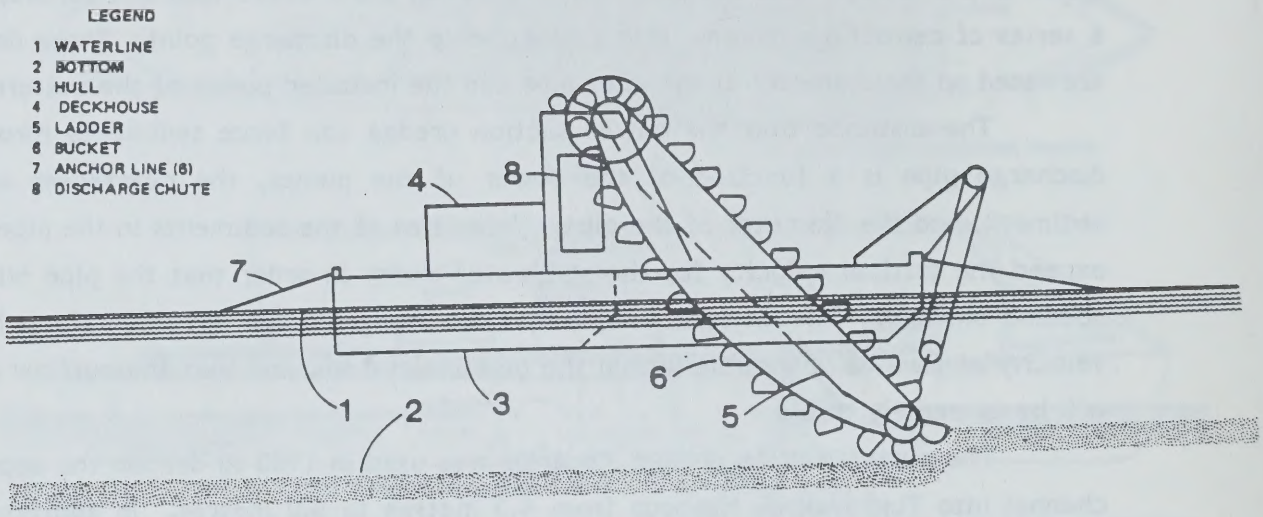
The distance that the cutter suction dredge can force sediments through a discharge pipe is a function of the power of the pumps, the coarseness of the sediment, and the diameter of the pipe. Velocities of the sediments in the pipe must exceed the critical velocity for the soil/water slurry in order that the pipe will not become blocked. This, in turn, means that the dredgemaster will maintain as high a velocity of flow as is possible within the pipeline system, and that the outflow slurry will be extremely turbid.

The cutter-suction dredge Aquarius was used in 1980 to deepen the approach channel into Tuktoyaktuk Harbour from 4.5 metres to 6.0 metres. In addition, the Aquarius produced approximately 500 000 $m^3$ of clean sandfill from Tuktoyaktuk Harbour in 1981 for the construction of a freshwater reservoir.

If the cutter suction dredge is located several kilometres from the discharge site, spill barges can be used to transport the fill. These barges generally transport 3,000 to 4,000 cubic metres of material and can discharge only through bottom doors. The loading of the barges continues using the overflow method described above until the barge is filled with between 80 and 100% solids.

2.1.1.3 Other Dredging Equipment Used in the Beaufort Sea

The other dredging vessels active in the Arctic at present are basically clamshell devices (Figure 1B). Neither bucket dredges (Figure 1B) nor dustpan dredges have been used in the region. The clamshells have generally been used for the excavation of "glory holes", for the sub-seabed placement of wellhead equipment, for clean-up and maintenance activities around artificial islands and for maintenance around shorebases. Such dredges generally employ terrestrial dragline technology to excavate the seabed and dump sediments directly into spill barges or dump directly from the surface close to the excavation. Additional information on the history of dredging in the Beaufort Sea including the amounts of spoil produced and the types of equipment used can be found in Franje (1983), EBA Engineering et al. (1984) and Taylor et al. (1985).



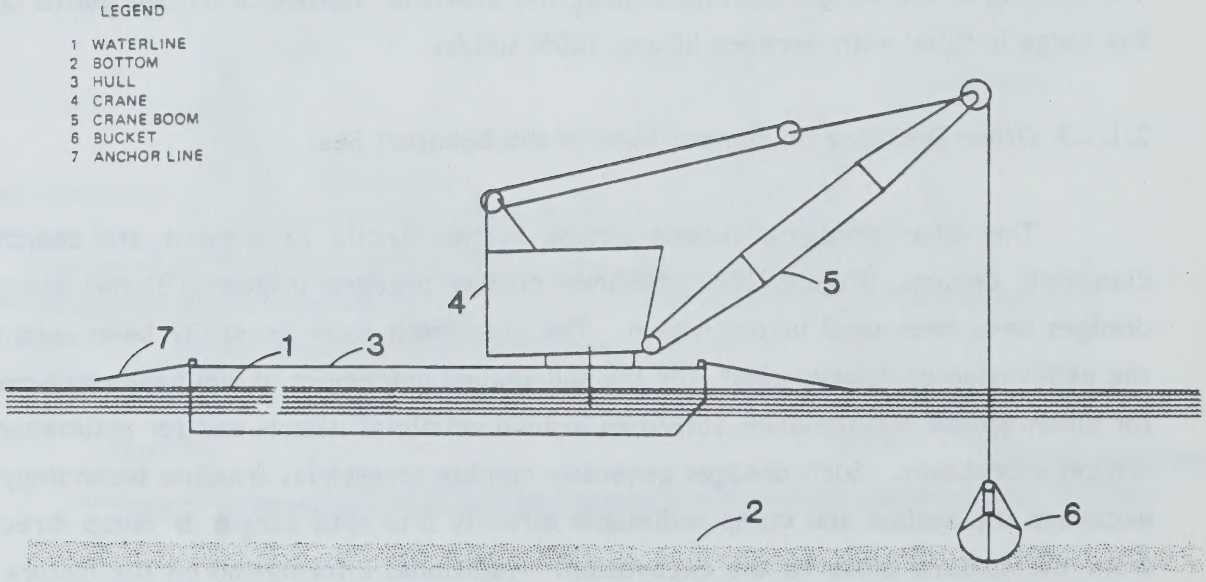




Figure 1B. Diagrams of bucket dredge (top) and clam shell dredge (bottom).

### 2.1.2 Future Dredging Developments in the Canadian Arctic

Future developments in the field of arctic dredging technology are contingent on oilfield development both in the Canadian and the Alaskan Beaufort Sea. Although no major dredging construction has taken place in Alaskan Arctic development, the move from an exploration to a production scenario would require the use of these construction techniques.

Brakel (1984) outlines the specialized dredging requirements of Beaufort Sea oil production. He notes that construction activities to date have required little more than adaptation of conventional equipment to the arctic working environment. New soil handling and placement techniques, however, have been developed that use conventional equipment, but provide fills that comply with stringent design specifications. Brakel (1984) also notes that the expansion of arctic dredging activities to support oil and gas production activities would require:

(a) greater yearly output, by the introduction of a larger dredging vessel having the capability of working in winter ice conditions; and,

(b) pipeline trenching, using equipment specially designed for the deep burial of pipelines and flowlines up to 5 metres below the seabed.

The need for soil improvement techniques will also increase as clean sand fill borrow sources are mined out. These techniqes may include hydrocyclone operations scaled to the relatively large production rates in dredging, in comparison with more typical mining projects.

Several oil companies active in Canadian Arctic development have been interviewed as part of this study to determine what equipment requirements they would have if production from offshore leases were to take place. The requirements of such a scenario would be to construct artificial islands, to excavate trenches for the protection of production flowlines, to excavate trenches for production pipelines, and to maintain these over the design life of the oilfield.

It is the opinion of the arctic operators that any production development plan would require an approximate doubling of the present hopper suction dredging fleet in the area and the deployment of trenching equipment specially designed for deep excavation. Gulf Canada Resources Inc. (pers. comm.) estimate that, for the

development of the Amauligak prospect, 1.2 million cubic metres of fill would have to be placed in the 1985 operating season, over 2 million cubic metres in 1986/87 and 8 million cubic metres by 1992. The development of an extremely large hopper dredge in the order of 10,000 cubic metres becomes a possibility for the placement of such fill quantities.

Esso Resources Canada Limited (pers. comm.) indicate more modest requirements. Unless significant changes occur in their current plans, they are not looking at major dredging increases in future development. They indicate that their projected requirements for the next few years will be at or below present levels. They see potential for the development of equipment for glory-hole excavation or subcutting requirements and also for the improvement of marginal fill materials.

Dome Petroleum Limited (pers. comm.) have no dredging plant on lease. Their marine drilling operation will require minimal gloryhole work which will be done using available equipment from other operators. No change is foreseen within the next two years, unless exploratory drilling operations from the single steel drilling caisson (SSDC) on an Alaskan prospect proceed.

Panarctic Oils (pers. comm.) conducted a feasibility study for using a submarine plough for shallow pipeline burial through the shoreline transition zone at Drake Point in 1982. Since that feasibility study was completed, their approach to the development of offshore reservoirs has changed entirely. The current concept involves using directional drilling technology to develop the offshore reservoirs from land, thereby avoiding any trenching or dredging requirements.

The dredging industry, as can be imagined, is more optimistic than the offshore operators about future excavation equipment developments. In addition to the development of the large arctic hopper dredge and the trench excavation equipment envisioned by the oil companies, they see opportunities for the development of equipment that could extend the dredging season through the winter months. The development of equipment for excavation in greater water depths is also being considered. Although all of these developments can be regarded as novel, they would probably be extensions of the currently available dredging technologies outlined above.

## 2.2 Worldwide Dredging Activities

On a mass basis, dredged-material disposal represents the greatest amounts of wastes deposited into the ocean. Two types of dredging activities can be

distinguished. The first, dredging for new construction is the relocation of natural sediment which might produce detrimental environmental changes due to physical and sedimentological alterations, but not due to chemical pollution. The second, maintenance dredging involves the removal of relatively recently deposited sediment from previously excavated channels and coastal areas. In many cases, this sediment has been contaminated with a wide variety of wastes that have spilled or been discharged into harbours, estuaries, rivers and coastal regions. In 1979, about one-quarter of all dredged material was dumped in the ocean and another two-thirds was deposited in wetlands and nearshore.

Although major dredging projects for new construction and maintenance occur on all continents, detailed summaries of the volumes of dredged material produced at these projects are largely unavailable. There are primarily two general sources of information available for obtaining a very rough assessment of the magnitude of global dredging and dredge-spoil disposal: (1) the Inter-Governmental Consultative Organisation (IMCO), and (2) the International Association of Ports and Harbours (IAPH). IMCO receives reports from some of the participating nations to the London Dumping Convention of the permits issued for waste disposal in the ocean. Use of the IMCO data are limited by the fact that (1) the quantities reported represent the amounts that have been authorised, not the amounts actually dumped in the ocean, and (2) only a small number of countries usually report their dredged material permits to IMCO. A preliminary global perspective on dredged-material disposal, based on IMCO data for 1979 is shown in Figure 2. An IAPH survey conducted in 1981 to compile the worldwide level of maintenance dredging in 1979 (International Association of Ports and Harbours, 1981) indicated that three countries (India, Kenya and Nigeria) accounted for about 50 percent of the reported dredging, yet these three countries were not included in the IMCO data.

Well-documented data on dredging activities are available, however, for some geographical locations. The OSLO Commission, for example, provides detailed dredging information for Northern Europe. Annual reports on the activities of the OSLO commission provide information on the amount and chemical composition of dredged materials dumped by each of the thirteen member states. The summary of the total amounts of dredge spoil dumped by Belgium, Denmark, France, Ireland, the Netherlands, Portugal and the United Kingdom during 1981 and the approximate location of the dumpsites are shown in Table 6. A broader perspective on worldwide dredging activities is given in Table 7 which summarizes the volumes of dredged

material produced during maintenance dredging activity in 1979 and dredging for construction purposes between 1975 and 1979.

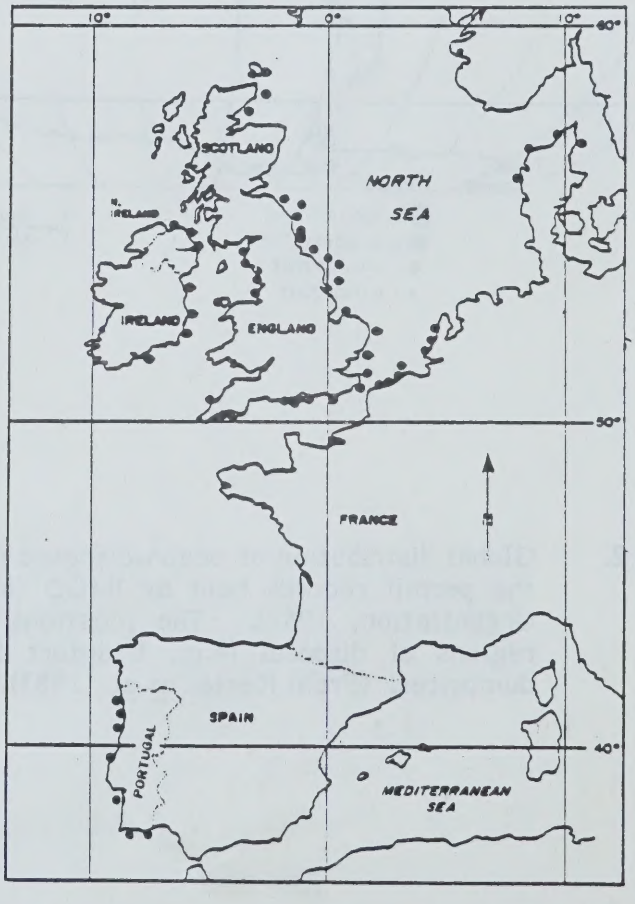
Dredging activity in the Canadian Beaufort Sea peaked in 1980, when 10.6 x $10^6$ $m^3$ of spoils were produced (Taylor et al., 1985). By comparison, this amount is about 12% of the total for Northern Europe in 1981 and only 0.5% of the worldwide dredge material volume for maintenance dredging in 1979.

**Figure 2.** Global distribution of ocean-disposed dredged material in 1979 based on the permit records held by IMCO (International Marine Consultative Organisation, 1981). The locations of the circles indicate general regions of disposal (e.g., Beaufort Sea) and do not imply specific dumpsites. (From Kester et al. 1983).

Table 6.

Amounts of Dredge Spoil Dumped in the OSLO Convention Area During 1981 (in $m^3$) (OSLO Commission, 1984)

| Country | Amount | % of Total |
|---|---|---|
| Belgium | 40 388 000 | 47.3 |
| Denmark | 629 000 | 0.7 |
| France | 5 231 000 | 6.1 |
| Ireland | 118 000 | 0.1 |
| Netherlands | 28 615 000 | 33.5 |
| Portugal | 607 000 | 0.7 |
| United Kingdom | 9 835 000 | 11.5 |
| | **85 423 000** | **100** |




Dredge Disposal Sites in the Area Defined by the OSLO Convention Area

Table 7.

Worldwide Dredged Material Volumes[1]
(in millions of $m^3$)

| Region | Maintenance[2] | Construction[3] | Total |
|---|---|---|---|
| Northern Europe | 547 | 1,235 | 1,782 |
| Mediterranean | 0.2 | 224 | 224.2 |
| Africa | 1,000 | 949 | 1,949 |
| Southern Asia | 318 | 1,859 | 2,177 |
| Southeast Asia | 134 | 34 | 168 |
| East Asia | 49 | 1,058 | 1,107 |
| South Pacific | 54 | 371 | 425 |
| North America | 208 | 104 | 312 |
| Caribbean | 5 | 25 | 30 |
| **TOTAL** | **2,315.2** | **5,859** | **8,174.2** |
| | (28%) | (72%) | (100%) |

1. Adapted from McLaren Plansearch, 1982.
2. For 1979.
3. For berth and channel construction during the period 1975 to 1979.

## 3. ENVIRONMENTAL EFFECTS OF DREDGING

Numerous possible environmental effects associated with dredging operations and the subsequent disposal of dredge spoils in aquatic environments have been reported in the literature (Cairns, 1968; Sherk and Cronin, 1977; Sherk et al., 1975; Sly, 1977; Burks and Engler, 1978; Stern and Stickle, 1978; Auld and Schubel, 1978; Wright, 1978; Hirsch et al., 1978; Pequeanat, 1978; Petticord and McFarland, 1978; Herbich, 1981a, b; Priest, 1981; Dome Petroleum et al., 1982; ESL, 1982; Levings, 1982; Great Lakes Water Quality Board, 1982; Kester et al., 1983; Pequegnat, 1983; Dillon, 1984; Lee and Jones, 1984; Nixon, 1984). In a recent review, Murden (1984) discusses the detrimental, incidental and beneficial effects of dredging and the related disposal of dredged materials:

### 1. Adverse effects of dredging operations

A. Adverse effects associated with operations at the dredging site.

- stationary dredgers may interfer with maritime traffic.
- stationary installations, such as underwater cables, pipelines, sewer outfalls, may be disturbed.
- objectionable noise levels.
- turbidity may be created by the dredging operation and by the overflow from hopper barges.
- the dredging operations or the turbidity caused by the operations may be visually objectionable.
- flora and fauna, including plankton, may be removed, or disturbed at the dredging site.
- beach erosion may be accelerated.
- trench dredging may be disadvantageous to trawler fishing operations.
- mining trenches may create stagnant areas.
- salinity wedge intrusions may be moved upstream.
- oxygen demands may be increased.

B. Adverse effects associated with the disposal of dredged materials in open water.

- turbidity may be created at the disposal site.
- environmental quality at the disposal site may be degraded when the material dredged is polluted.
- flora and fauna at the disposal site may be smothered or disturbed.
- salinity and pollution may enter the ground water adjacent to disposal areas.
- toxic substances, which may be assimilated and stored by marine fauna, could proceed through the food chain to the human population.
- pollution or discolouration of recreational area facilities and beaches.

## 2. Beneficial effects of dredging operations

A. Beneficial effects associated with operations at the dredging site.

- water flow conditions may be improved and provide flood control benefits.
- navigation conditions may be improved.
- polluted sediments may be removed and/or capped with clean materials.
- construction materials (sands and aggregates) may be provided for concrete mix, for landfill, and for building dykes and levees.
- beach nourishment may be provided by placement of the material in the littoral zone.
- minerals and gems may be obtained.
- hurricane protection may be provided by the construction of dunes along the shorelines of coastal areas.

B. Beneficial effects associated with the disposal of dredged materials in open water.

- underwater mounds may be created which provide fish and wildlife refuge areas.
- existing bottom pollution may be controlled by applying a cover of non-polluted dredged materials.
- soft bottoms may be created, with the potential to produce an increased biomass.
- nutrients may be added in oligotrophic waters.
- artificial marsh areas may be created.
- new land may be created adjacent to the coast
- islands for wildlife habitat may be created.
- salinity wedge limits and dimensions may be controlled.

C. Incidental beneficial effects associated with dredging operations at the dredging sites.

- pollution may be removed from the bottom surface of the site.
- eutrophication may be controlled or eliminated.
- nutrients from the bottom sediments may be re-suspended in the water column, becoming available to aquatic biota.
- the oxygen content of the water in the water column may be increased by mixing due to turbulence.
- sediments may be re-oxygenated.

Most of the information on the environmental effects of dredging found in the literature is focussed primarily on activities taking place in North America. Although many large dredging projects have taken place in other regions of the world such as Asia, the Middle East and Africa, it appears that very few environmental studies have been undertaken in conjunction with these projects. When studies are conducted, they tend to focus on aspects of industrial pollution in the dredging area and on monitoring to determine the effectiveness of special techniques and

equipment to limit the disturbance of contaminated sediments and lead to improved water quality rather than the effects of dredging per se. Murden (1984) notes that the changes related to chemical and mineral pollution are seen primarily as the result of the introduction of contaminants into the waters by others and, therefore, should not be attributed to dredging. In addition, in many parts of the world, the effects of dredging and disposal activities are usually taken to be far less objectionable than the effects on the environment resulting from natural causes such as the transfer or movement of materials caused by floods and storms.

An extensive monitoring programme (the Joint Monitoring Programme) has been underway in the OSLO Convention area since 1978 (OSLO Commission, 1984). This programme is directed at assessing the environmental implications of the dumping of wastes in the ocean. Although the dumping of dredge spoils is one category of waste monitored by the Commission, no attempt is made to distinguish the environmental effects resulting from the ocean disposal of dredge spoils from those resulting from the dumping of industrial wastes or sewage sludges. The objectives of the Joint Monitoring Programme are:

(1) the assessment of possible hazards to human health;

(2) the assessment of harm to living resources and marine life (ecosystems);

(3) the earliest possible assessment of the existing level of marine pollution; and

(4) the assessment of the effectiveness of measures taken for the reduction of marine pollution within the framework of the Convention.

The approach to meeting the above objectives has been monitoring of cadmium, mercury and PCBs in marine organisms.

Figure 3 outlines the pathways of some of the direct and indirect physical, chemical and biological effects of dredging operations in marine environments. Most of the effects associated with dredging operations, however, are related primarily to two factors (1) the resuspension of sediment particles; and (2) excavation of substrate and increased sedimentation near the dredging operation and disposal site.

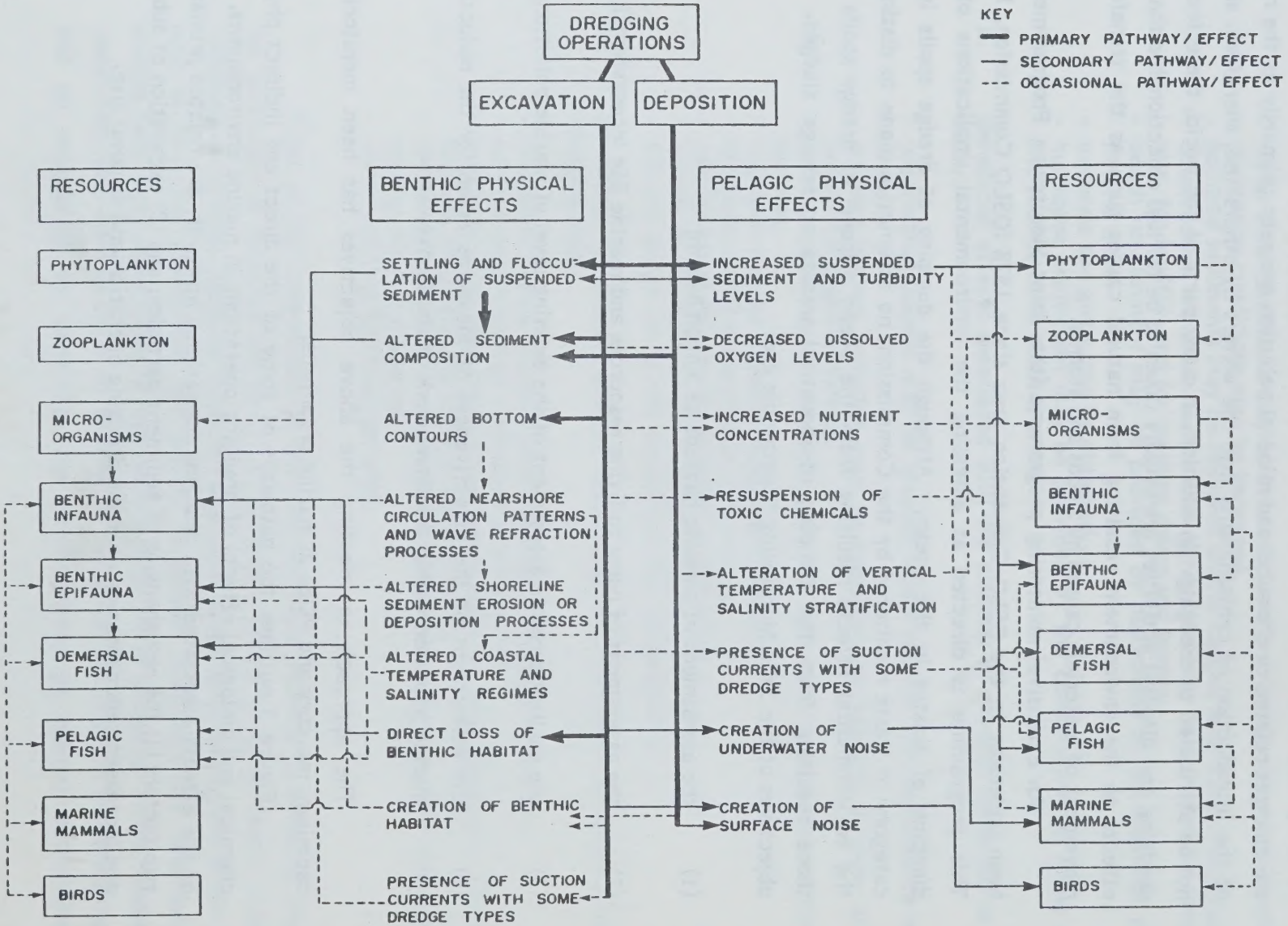



Figure 3. Pathways of some direct and indirect physical and biological effects of dredging operations in marine environments. (Based on ESL 1982).

It is clear that environmental effects are certain to occur during and after dredging and disposal operations in aquatic environments. It is important to distinguish the effects which may be long-term and have the potential for environmental degradation on local and regional scales from those which are short-term and short-range which usually cause change within the immediate receiving environment but seldom cause environmental degradation. This section focusses on the major effects identified in previous studies of dredging operations and some of the general conclusions reported by the Dredged Material Research Program conducted by the U.S. Army Corps of Engineers. The effects of dredging operations are not unique to each dredging project; the effects noted in North American waters are generally equivalent to those observed in Japan, Northern Europe and other areas where dredging operations are undertaken. In Japan, for example, the major adverse effects associated with dredging reported in the literature include: (1) the generation of turbidity in the water column through resuspension of bottom sediments (Kasajima, 1984); and (2) the deterioration of water quality through the release of toxic materials and nutrients from contaminated dredge spoils (Kaneko et al. 1984; Hamaguchi, 1982; Yoshida, 1984). Much of the research carried out in Japan in the area of environmental effects of dredging and dredge spoil disposal has been directed primarily at reducing the turbidity generated during dredging and limiting the release of contaminants. The main approach toward the reduction of turbidity has been the development of specialized dredges and dredging technology which limit or eliminate the sediment suspension during dredging (Kaneko et al. 1984; Koba and Shiba, 1983; see Section 4.1). Reduction in resuspension during dredging has also been used as a strategy for limiting the release of contaminants. Oshita (1982) has recently proposed the SIL-B Treatment Method as a means of limiting the release of contaminants during dredging. By this method, contaminated bottom sediments are treated with a silicic coagulent to immobilize contaminants and to bind sediments into a hydrogel that can be removed easily with conventional dredging equipment.

Dredging has taken place in association with North Sea oil development primarily in conjunction with wellhead-to-land oil and gas pipelines. No major environmental effects studies have been conducted in association with these dredging projects because of the limited concerns about possible environmental effects (C. Johnston, pers. comm.).

## 3.1 Effects Related to Resuspension of Sediment

When bottom sediment is excavated by dredges, an increase in water column turbidity results. In general, it is the dredging process, not the disposal process, that produces the greater amount of turbidity. It is recognized, however, that it is the ultimate disposal of the dredged material which has the maximum potential for short and long-term adverse environmental effects (Khan and Grossi, 1984). The extent of the turbid plume is related to many factors including the type of dredge, the rate at which excavation is taking place, water column characteristics, characteristics of the substrate and the nature of the dredging operation. It is the cloudiness associated with turbidity that causes unfavourable public response to some dredging projects because of the adverse effects that turbidity can have on the beneficial uses of water in waterways, near open water disposal sites and in areas where confined disposal overflow occurs. The resuspension of sediment also results in the injection of interstitial fluids into the water column and release of nutrients, metals and oxygen-consuming organic matter. "Short-term" degradation of water quality usually results. ("Short-term" usually implies that the return to background conditions following association of dredging or disposal activities occurs within hours or days.) Biological effects of turbidity include local scale disruption of migration patterns of mobile organisms, disruption of feeding patterns and alterations to the rate of primary production. Lunz et al. (1984) stress that organisms with limited avoidance capabilities and those having life history stages which are sessile or non-mobile are particularly susceptible to the effects of suspended sediments. Concerns in this category include: (1) survival and development of egg and larval stages of fish; (2) survival and development of egg and larval stages of shellfish; (3) survival and movements of juvenile fish and shellfish; (4) survival and movements of subadult and adult shellfish; and (5) survival and movements of subadult and adult fish.

Of particular concern is the release of toxins into the water column from dredge spoils contaminated with metals (such as mercury, cadmium, arsenic, chromium, copper and lead), petroleum hydrocarbons, pesticides, PCBs and a variety of synthetic organic compounds associated with man's industrial activities because there is strong evidence that these contaminants can enter and modify the food chain from sediments. The biological consequences of contaminant uptake by organisms, however, remain poorly understood (Dillon, 1984). Biomagnification, the increasing concentration of a substance along increasing trophic levels of a food web, appears to

be contaminant specific. Swartz and Lee (1980) report, for example, that biomagnification occurs for mercury, DDT and its degradation products, and PCBs such as Aroclor 1254, but apparently does not occur for many other metals including cadmium, chromium, copper, lead and zinc. Investigations by Fulk, Gruber and Wullsheleger (1975) showed that basically all contaminants transferred to the water column were associated with the resuspension of solids rather than desorption processes. Consequently, the spread of contaminants during dredging is linked to the resuspension of sediments, particularly clay-sized particles and organic particles which have an affinity for chlorinated hydrocarbon pesticides and PCBs.

The definition of contaminated sediment has been somewhat arbitrary. Several attempts have been made to establish criteria for distinguishing natural and contaminated sediment. These have included:

1. The Jensen criteria set by the U.S. Environmental Protection Agency in 1971. A sediment is considered contaminated if one or more of its properties exceeds a permissible limit (Engler, 1980). These criteria have been seriously criticised because they are based on bulk sediment analysis which has been shown subsequently to be a very poor indicator of potential biological effects.

2. The elutriate test adopted by EPA in 1973 (Keeley and Engler, 1974). A sediment is considered contaminated by this test if the elutriate procedure of resuspending 1 part of sediment in 4 parts of water (both by volume) increases the concentration of a contaminant in the aqueous phase by more than 50%.

3. The bioassay test adopted by the EPA in 1977. Liquid-phase, suspended solids and solid-phase bioassay measurements are used to determine the presence of significant amounts of contaminants in a sediment. The bioassay tests for lethality of each phase and for bioaccumulation relative to a reference sediment. Specific guidelines for conducting these bioassays are carefully outlined.

4. State of Connecticut Classification of Contaminated Sediment (New England River Basins Commission, 1979). Class I sediments are considered to be

nondegrading to water quality and non-toxic to marine organisms; Class II are moderately contaminated but are suitable for island or marsh habitat development and for open ocean disposal; Class III are contaminated and potentially hazardous. If bioassays indicate that Class III sediments are toxic, they cannot be ocean dumped; they must be disposed on land or contained at inshore locations.

| Parameter | Class I | Class II | Class III |
|---|---|---|---|
| Silt and clay (%) | < 60 | 60 - 90 | > 90 |
| Water content (%) | < 40 | 40 - 60 | > 60 |
| Volatile solids (%) | < 5 | 5 - 10 | > 10 |
| Oil and grease (%) | < 0.3 | 0.3 - 1.0 | > 1 |
| Mercury ($\mu g\ g^{-1}$) | < 0.5 | 0.5 - 1.5 | > 1.5 |
| Lead ($\mu g\ g^{-1}$) | <100 | 100 - 200 | > 200 |
| Zinc ($\mu g\ g^{-1}$) | <200 | 200 - 400 | > 400 |
| Arsenic ($\mu g\ g^{-1}$) | < 10 | 10 - 20 | > 20 |
| Cadmium ($\mu g\ g^{-1}$) | < 5 | 5 - 10 | > 10 |
| Chromium ($\mu g\ g^{-1}$) | <100 | 100 - 300 | > 300 |
| Copper ($\mu g\ g^{-1}$) | <200 | 200 - 400 | > 400 |
| Nickel ($\mu g\ g^{-1}$) | < 50 | 50 - 100 | > 100 |
| Vanadium ($\mu g\ g^{-1}$) | < 75 | 75 - 125 | > 125 |

5. The OSLO Commission (1984) has issued the following criteria for defining contaminated waste and sediment:

| | |
|---|---|
| mercury: | 0.3 mg (dissolved) Hg per litre of waste |
| cadmium: | 1.0 mg (dissolved) Cd per litre of waste |
| organohalogen and organosilicon compounds: | When a waste can be tested in its complete form, the concentration in sea water within 5 minutes after discharge shall not exceed the 96 h LC-50 for the most sensitive test organism in the standard test procedure as outlined in the OSLO Commission Guidelines for Test Procedures. |

6. In Canada, Ocean Dumping Control Act criteria are used to identify contaminated sediment as follows:

| Contaminant | Concentration |
|---|---|
| mercury and its compounds: | > 0.75 mg $kg^{-1}$ (solid phase); > 1.5 mg $kg^{-1}$ (liquid phase) |
| cadmium and its compounds: | > 0.60 mg $kg^{-1}$ (solid phase); > 3.0 mg $kg^{-1}$ (liquid phase) |
| organohalogen compounds: | > 0.01 of toxic level |
| "oil and grease" | > 10 mg $kg^{-1}$ |

### 3.1.1 Influence of Dredge Type on Sediment Resuspension

Extensive reviews of the literature concerning sediment resuspension caused by dredging were conducted by Barnard in 1978 and more recently by Herbich and Brahme (in press). They found that most **conventional dredges** create plumes of silt and clay-sized particles or small flocs that settle through the water column at very slow rates. Although the solids concentration in the water column in the vicinity of the dredging operation usually does not exceed several hundred milligrams per litre, the particles continue to settle until eventually, the solids concentration near the bottom can exceed 10 g $L^{-1}$. Barnard (1978) referred to this level of solids concentration (0 to 10 g $L^{-1}$) as turbidity (Figure 4). Higher concentrations take on the properties of fluid mud. Barnard noted that the nature, degree, and extent of sediment resuspension are controlled by many factors, including characteristics of the sediment, hydrologic regime, and hydrodynamic forces.

The combination of mechanical and hydraulic systems in the **cutterhead dredging system** makes it one of the most versatile and widely used dredging systems; however, its use also increases the potential for sediment resuspension. While a properly designed cutter will cut and guide the bottom material toward the suction efficiently, the cutting action and the turbulence associated with the rotation of the cutter resuspend a portion of the bottom material. The level of sediment resuspension is directly related to the type and quantity of material cut but not picked up by the suction. The ability of the dredge's suction to pick up bottom material determines the amount of cut material that remains on the bottom or is resuspended.

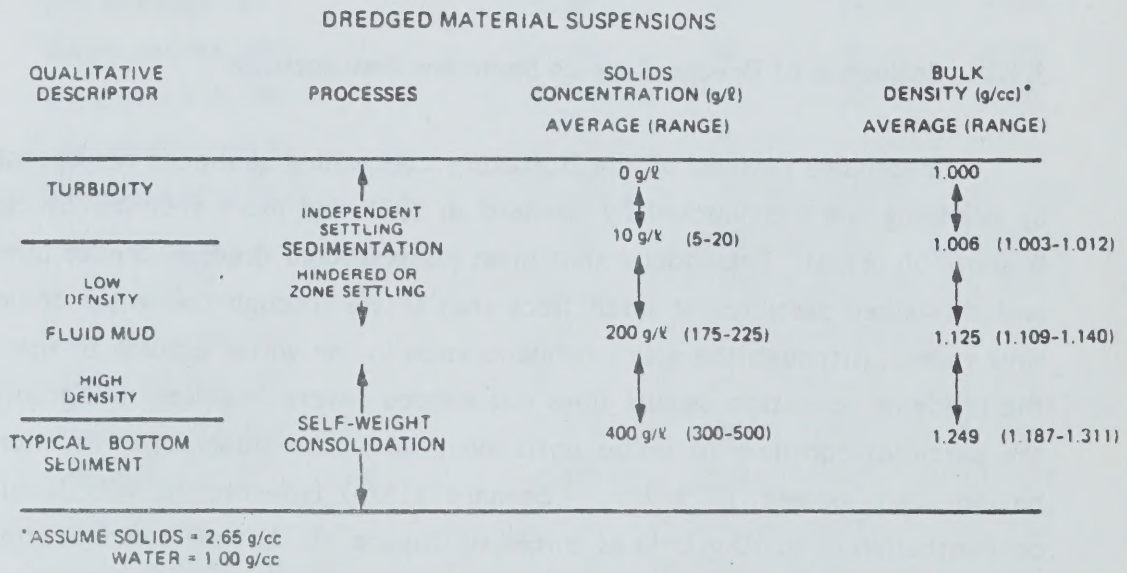



**Figure 4.** Characteristics of Suspended Solids in Water Column in the Vicinity of Dredging and Disposal Operations (Barnard, 1978).

While little experimental work on cutterhead resuspension has been done, several field studies have attempted to identify the extent of cutterhead resuspension. Barnard (1978), reporting on the field investigations of Huston and Huston (1976) and Yagi et al. (1975), stated that, based on the limited field data collected under low current conditions, elevated levels of suspended material appear to be localized in the immediate vicinity of the cutter as the dredge swings back and forth across the dredging site. Barnard (1978) stated that within three metres of the cutter, suspended solids concentrations are highly variable, but may be as high as a few tens of grams per litre; these concentrations decrease exponentially with depth from the cutter to the water surface. Near-bottom suspended solids concentrations may be elevated to levels of a few hundred milligrams per litre at distances of 300 m from the cutter.

Recent field tests and literature reviews by the Waterways Experimental Station (WES) (Raymond, 1984) have found cutterhead resuspension to be substantially less than discussed by Barnard. Sediment resuspension within 30 m of the cutter has seldom been found to exceed 1 000 mg $L^{-1}$. Figure 5 is a schematic representation of average suspended sediment values observed during a 45-cm cutterhead operation in the James River (Raymond, in preparation). These values are a 4-day average and represent the actual suspended sediment levels, as determined by gravimetric analysis, less the background suspended sediment levels for the appropriate depth and current. Therefore, a value of zero means there is no increase above background, not that the level of suspended sediment is zero. This figure highlights several characteristics of cutterhead dredges. First, as pointed out by Barnard (1978) and Herbich and Brahme (in press) and suggested by intuition, depth has an important correlation to suspended sediment level. Secondly, even though the plume of resuspended material has its source at the bottom, some material appears to move upward surprisingly fast. This upward movement is probably connected to the action of the cutter. Finally, the effect of the different average ambient current speeds can be seen. The higher current speed at ebb tide appears to propel the resuspended sediments higher in the water column, thus making the overall average suspended sediments higher in the water column. This, in turn, makes the overall average suspended sediment values higher for the ebb than for the flood. The salinity remained similar during both phases and well below the level required to produce stratification. The average suspended sediment values of the flood and ebb for the upper water column (8 m level and above) are 11.5 mg $L^{-1}$ and 37.5 mg $L^{-1}$,

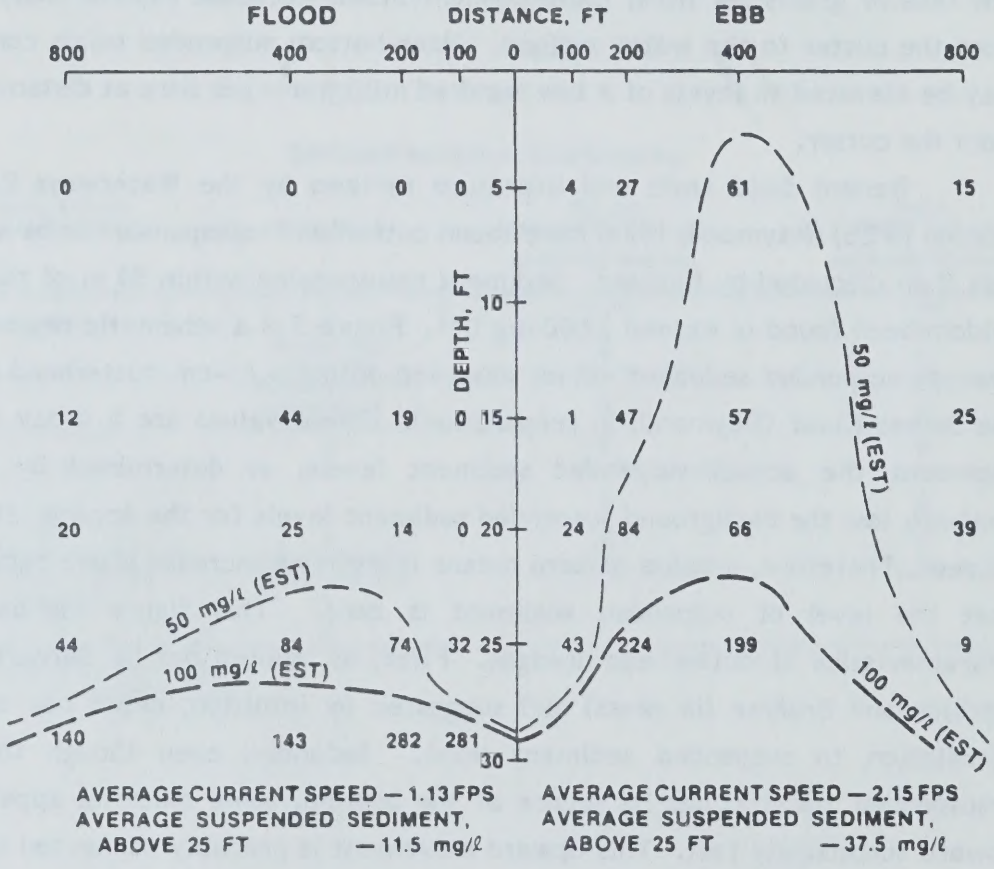



**Figure 5.** Schematic Representation of Average Suspended Sediment Value for Indicated Depths and Distances.
James River Cutterhead test (Raymond, 1984).

respectively. This difference is statistically significant at the 95-percent confidence level. In this case, the effects of dredging in higher current velocity will be magnified over that of lower current velocities. It appears that for current speeds in the 60 cm $s^{-1}$ range, the sediment was sufficiently hindered to prevent the same settling rate that occurred at the lower current velocities. This effect cannot be confirmed in the lower water column, however.

Resuspension of fine-grained sediment during **hopper dredge** operations is caused by the dragheads as they are pulled through the sediment, the turbulence generated by the vessel and its propeller wash, and the overflow of turbid water during hopper filling operations. Field data confirm that the suspended solids levels generated by a hopper dredge operation are primarily caused by hopper overflow in the near-surface water and draghead resuspension in near-bottom water. In the immediate vicinity of the dredge, a well-defined upper plume is generated by the overflow process and a near-bottom plume by draghead resuspension; 275 to 350 m behind the dredge, the two plumes merge into a single plume (Figure 6). As the distance from the dredge increases, the suspended solids concentration in the plume generally decreases, and the plume becomes increasingly limited to the near-bottom waters. Suspended solids concentrations may be as high as several tens of grams per litre, near the discharge port and as high as a few grams per litre near the draghead. Suspended sediment levels in the near-surface plume appear to decrease exponentially with increasing distance from the dredge due to settling and dispersion, and the levels quickly reach concentrations of less than one g $L^{-1}$. However, plume concentrations may exceed background levels observed at distances in excess of 1,100 m (Barnard, 1978).

The sediment removed by **mechanical dredges** is at nearly <u>in situ</u> density; however, the production rates are low compared to those for a cutterhead dredge, especially in consolidated material. The dredging depth is practically unlimited, but the production rate drops with increased depth. The **clamshell dredge** usually leaves an irregular, cratered bottom. The resuspension of sediments during clamshell dredging is caused primarily by the impact, penetration, and withdrawal of the bucket from the bottom sediments. The effect of this material is usually limited to the near bottom. Secondary causes are loss of material from the bucket as it is pulled through the water, spillage of turbid water from the top and through the jaws of the bucket as it breaks the surface, and inadvertent spillage while dumping. This secondary loss of material affects the entire water column.

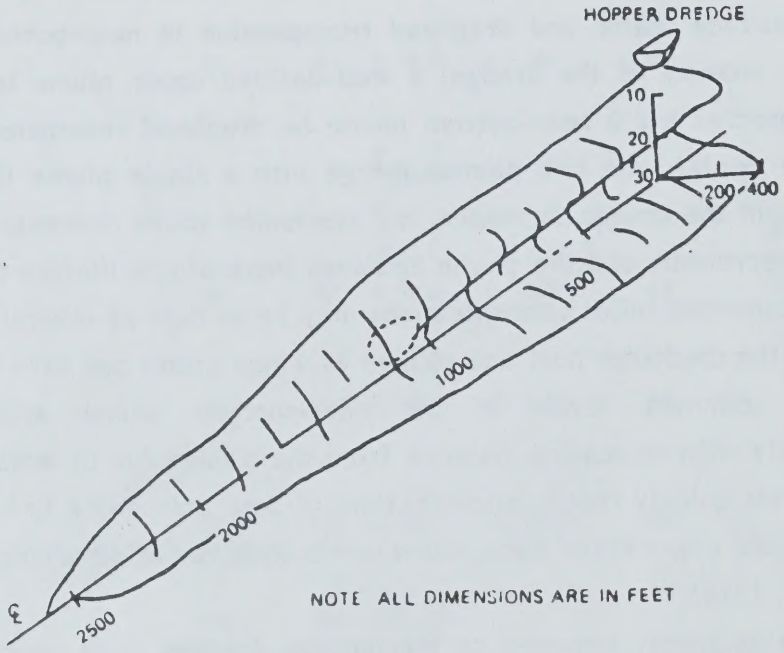



**Figure 6.** Postulated Double Plume Resulting from Hopper Dredge Operations (Barnard, 1978).

Limited field measurements of sediment resuspension caused by clamshell dredges showed that the plume downstream of a typical operation may extend approximately 300 m at the surface and 450 m near the bottom. It was also observed that the maximum suspended sediment concentration in the immediate vicinity of the dredging operation was less than 500 mg $L^{-1}$ and decreased rapidly with distance from the operation due to settling and mixing effects (Barnard, 1978).

### 3.1.2 Selection of Dredge Type to Minimize Sediment Resuspension

When planning a dredging operation, the project engineer may be faced with the problem of selecting the best dredge based on the cost and availability of different dredges, the operating conditions at the project site, the material to be dredged, the job specifications, and the various environmental considerations. Since each dredging/disposal project is site-specific, a dredge that might be ideal in one situation may not be suitable for another.

The results of field studies may provide some insight into dredge selection when limiting sediment resuspension is an important factor. Wakeman, Sustar, and Dickson (1975), based on their work on San Francisco Bay, state "the cutterhead dredge (sic) seems to have the least effect on water quality during the dredging operation. This is followed by the hopper dredge without overflow. The clamshell dredge and hopper dredge during overflow periods both can produce elevated levels of suspended solids in the water column". Herbich and Brahme (in press), discussing comparisons of the sediment resuspension potential of different dredges operating in clay, found that the trailing suction dredge (without overflow) and the cutterhead dredge had a similar resuspension potential, whereas the clamshell dredge was determined to produce about two and a half times as much resuspension. Field tests conducted by Raymond (1983) also support this. The following tabulation was constructed from Raymond's test results and summarizes the effects of clamshell bucket dredge and a cutterhead dredge operating in similar fine-grained sediments.

| | Resuspended Sediment, mg $L^{-1}$ | |
|---|---|---|
| **Dredge Type** | **Water Column** | **Near Bottom** |
| Cutterhead | 35 | 134 |
| Clamshell | 106 | 134 |

These data were normalized with respect to hydrodynamic conditions and background levels of suspended sediment. The values represent the average of all samples taken within 250 m of the dredge along similar radials. The tabulation shows that while the effect of the cutterhead and the clamshell are similar at near-bottom levels (approximately 0.3 - 1.5 m from the bottom), the cutterhead's effect is much less than the clamshell's in the upper water column.

## 3.2 Effects Related to Excavation of Substrate near the Dredging Location and Increased Sedimentation at the Disposal Site

The immediate effects of excavation are the destruction of many of the benthic organisms contained within the dredged material and exposure of new habitat. At the disposal site, benthic organisms are buried, many are lost to suffocation and a change in grain size and texture of sediment often occurs which can lead to a long-term shift in the structure of the benthic community. Potential long-term degradation of the environment resulting from dredge material disposal is an issue associated primarily with contaminated sediment except in extremely sensitive or unique areas.

The benthic zone is the portion of the receiving environment most susceptible to the effects of dredge spoil disposal because of the potentially long period of exposure to contaminants and physical disruption of habitat, although the extent of the area affected is usually limited to approximately 500 metres around dredging and disposal areas (Lunz et al., 1984). Long-term degradation may manifest itself in the form of sublethal effects occurring within the biological community that inhabits disposal sites which receive continuous and large amounts of dredged material. Biomagnification of a particular component in a contaminated dredged material and genetic disorder are two examples of sublethal effects which could go unnoticed for years. Since it is difficult to anticipate all long-term effects, most jurisdictions have opted to follow a very cautious management strategy regarding contaminated sediments. Consequently, dredging and disposal of contaminated sediments are usually subject to stringent controls which it is hoped will reduce the chance for future "surprise" effects resulting from prolonged exposure to even very low concentrations of contaminants.

## 3.3 Influence of the Receiving Environment Characteristics on the Effects of Dredging and Dredge Spoil Disposal

The extent and duration of environmental effects resulting from dredging operations and dredge spoil disposal will depend on the physical, chemical, geological and biological properties of the environment where the activities are taking place. An in-depth understanding of the oceanography or limnology of the activity areas is essential for understanding the behaviour of dredged material in the environment and any implications for biological effects. A comparison of the importance of some of the possible environmental effects of dredging in coastal marine zones and estuaries, offshore environments and river/lake systems is given in Table 8. Shallow coastal areas and estuaries are usually characterized by very large seasonal and daily variations in suspended solids, temperature, salinity, dissolved oxygen, tides, wave conditions, currents and nutrient concentrations. Organisms that inhabitat shallow coastal zone areas are believed to have developed physiological and biochemical strategies for coping with the high variability in their surroundings. Consequently, changes to the physico-chemical environment resulting from dredging of uncontaminated sediments in these areas are not likely to result in any significant biological effects. A few exceptions to this general case include disruption of spawning sites and effects on juvenile fish if the area is important for rearing.

The major environmental concerns remain primarily with the dredging and disposal of contaminated wastes and activities in sensitive areas such as nursery or spawning grounds. Characteristics of the receiving environment provide a useful tool for anticipating potential impacts. Shallow, poorly flushed coastal embayments may be particularly susceptible to adverse effects from dredge material disposal when contaminated sediments or sediments having a high oxygen demand are present. Dynamic environments, on the other hand, can show a strong resilience to the introduction of continual inputs of large quantities of wastes. The New York Bight area is an example of such an environment. Throughout the past century, the New York Bight has received large quantities of contaminated dredge spoils, sewage sludge, garbage and chemical wastes including synthetic chemicals (Conner et al., 1979). The concentrations of toxic contaminants in the New York Bight, however, are at present not extreme because the Bight is a moderately dispersive ecosystem and because it is effectively flushed by the Atlantic Ocean. Contaminant concentrations in edible seafoods are within safe limits, although higher than "pristine" areas and are not considered of any threat to human health (Plugge et al.,

Table 8.

Comparison of Short-term Effects of Dredging Operations and Dredged Material Disposal
Between Shallow Coastal Marine and Estuarine Environments, Marine Offshore Environments and Freshwater Environments

| Effect | Shallow Coastal Marine and Estuarine Environments | Marine Offshore Environments | Freshwater Environments (Lakes, Rivers) |
|---|---|---|---|
| Turbidity (and suspended particulate matter): | | | |
| 1. Reduce light penetration | Can be important to phytoplankton and phytobenthos. (Sometimes reduction in productivity is offset by stimulation of productivity due to released nutrients) | Little phytoplankton and no phytobenthos | Can be important to lake phytoplankton and phytobenthos. (Sometimes reduction in productivity is offset by stimulation of productivity due to released nutrients) |
| | Can have effects on hermatypic corals | No reef building corals | No reef building corals |
| 2. Flocculate phytoplankton | Can be important in estuaries and above thermocline in neritic waters | Little effect | Can be important on local scale |
| 3. Aesthetically displeasing | Strong possibility | Little effect | Strong possibility in lakes |
| 4. Decrease availability of food | May be important<br>Dilution of food particles with useless material<br>May also increase food supply | May increase food supplies<br>Carry organic matter (POC) | May be important<br>Dilution of food particles with useless material |
| 5. Drive mobile organisms out of an environment | Temporary effect | Animals adapted to nepheloid layer | Temporary effect |
| 6. Affect respiratory surfaces of adult fish and invertebrates | Can be important within 500 m of dredge | Dilution and dispersion reduces potential effect | Can be important in lakes where organisms are not adapted to turbid conditions, but effects would likely be limited to within 500 m of the dredge. |
| 7. Release and subsequent sorption of toxic materials | Can be important to filter-feeders and sediment reworking polycheates | Widely dispersed, reduced number of of filter-feeders | Can be important to filter-feeders and fish. Metals, chlorinated hydrocarbons and other contaminants usually more toxic in freshwater systems than in estuarine systems. Release of nutrients may lead to entraprication on local scale in shallow areas. |
| 8. Affect development of eggs, larvae and juvenile fish and shellfish | Can be important on local scale | Little effect due to wide dispersion | Can be important on local scale |
| 9. Interrupt spawning migration | Can be important on local scale | Little effect | Can be important on local scale |

Table 8, cont'd.

Comparison of Short-term Effects of Dredging Operations and Dredged Material Disposal
Between Shallow Coastal Marine and Estuarine Environments, Marine Offshore Environments and Freshwater Environments

| Effect | Shallow Coastal Marine and Estuarine Environments | Marine Offshore Environments | Freshwater Environments (Lakes, Rivers) |
|---|---|---|---|
| Bottom Sediment Buildup: | | | |
| 1. Smother benthic organisms | Can be important because biomass high High proportion of epibenthic species | Less important because biomass low Also higher proportion of infaunal species | Can be important |
| 2. Destroy spawning areas | May be important | Relative effects unknown | May be important locally |
| 3. Reduce phytobenthos cover | Locally important to sea grass beds | No sea grass beds | Locally important to grass beds |
| 4. Effect on bottom habitat diversity (change in grain-size distribution) | May reduce diversity and change community structure | Probably will increase habitat diversity by introduction of coarse material Community effects determined by species preferences and availability of colonizing organisms. | May reduce diversity and change community structure |
| Depletion of Dissolved Oxygen: | | | |
| 1. Suffocate organisms | Important, but species specific | Anoxia not as severe a problem in deep sediments | Important but species specific |
| 2. Can cause release of materials | Important locally | Lower concentrations will occur in waters | Important locally |
| 3. Interrupt spawning migration | Can be important locally | Little effect | Can be important locally |
| Entrainment: | | | |
| 1. Loss of fish | Can be important if spawning or migratory concentrations occur | Little effect since fish are widely dispersed | Can be important if spawning or migratory concentrations occur |

1983). Although initial monitoring studies in the New York Bight have indicated that the Bight appears to have suffered no irreversible ecological damage during the past century, monitoring programmes directed at assessing long-term sub-lethal effects are continuing.

Lake systems may, on the other hand, be more susceptible to the effects of turbidity and release of nutrients and toxins than marine areas because turbid plumes can persist for very long time periods in fresh water. In a saline environment, whether fresh water sediment is discharged into saline water or whether a saline sediment is discharged into fresh water, flocculation occurs rapidly (Wechsler and Cogley, 1977). Furthermore, the toxic action of pollutants tends to be greater in freshwater than in saline environments due to the limited concentration of neutralizing and complexing agents in freshwater.

## 3.4 Overview of Results of Studies on the Environmental Effects of Dredging with Emphasis on the Results of the U.S. Army Corps of Engineers Dredged Material Research Program

The U.S. Army Corps of Engineers conducted a five year research program into the environmental effects of dredging and dredging disposal between 1973 and 1978 at a cost of $33 million (The Dredged Material Research Program (DMRP)). The program was in response to the expectation expressed by many people that annual dredging and disposal of approximately 370,000,000 cubic metres of sediments in the rivers, lakes and coastal regions of the United States would cause major short-term effects and substantial long-term environmental impacts on aquatic organisms and habitats. The DMRP was designed to be applicable across the U.S. with no major type of dredging activity, region or environmental setting excluded. Since 1977 research by the Corps of Engineers has continued under several new programs (e.g., Long-Term Effects of Dredging Operations Programme (LEDO); Field Verification Programme (FVP); Improvement of Operations and Maintenance Techniques (IOMT) Programme: Dredging Contaminated Sediments Section). These programmes are outlined in greater detail in Section 5).

Some general conclusions derived from the research conducted to date by various groups into the environmental implications of dredging and disposal operations in aquatic environments which have been reported in the literature include:

1. "Recent research results from a major research effort by the U.S. Army Engineer Waterways Experiment Station indicate that the original fears of water quality degradation resulting from the resuspension of the dredged material during dredging operations are for the most part unfounded." (Herbich, 1981a).

2. The greatest impact of dredged material disposal is the potential effect on benthic organisms, but the scale of the effects is usually confined to an area within about 500 metres of the dredging operation (Lunz et al., 1984).

3. No significant long-term increases in water column contaminant concentrations have been observed at any aquatic disposal field studies in U.S. Waters (Brannon, 1978).

4. The magnitude of release of the various contaminants to the water column was found to correlate poorly or not at all with physical and chemical characteristics of the dredge spoils (Jones and Lee, 1978).

5. Most organisms studied were relatively insensitive to the effects of sediment suspensions (Hirsch et al., 1978).

6. Release of heavy metals and their uptake into organism tissues have been rare as has been the accumulation of oil and grease residues by organisms. (Hirsch et al., 1978).

7. Pequegnat et al. (1978) studied biological impacts of dredged material on phytoplankton, zooplankton, nekton and benthos and concluded that impacts associated with deep-water disposal of dredge spoils are either negligible or that disposal will not cause significant or long lasting damage to marine organisms.

8. It is difficult to identify a specific case in which the disposal of dredged material has produced an environmental crisis (Kester et al., 1983).

9. While there is evidence that contaminants can enter and modify the food chain from sediments, the predictive understanding of these processes is still very poor. There are no clear case studies from which one can infer that contaminated dredged material has affected the food chain (Kester et al., 1983).

10. The focus of current research is being placed on disposal strategies for contaminated wastes and evaluation of potential long-term environmentally consequential sub-lethal effects on aquatic organisms. Effects related to uncontaminated dredged materials are considered negligible. (An exception is dredging/disposal in sensitive biological areas such as spawning or nursery grounds but the effects will depend on the scale of the disturbance.

11. Environmental concerns about dredging expressed by various private citizens and public interest groups can not be dealt with on a technical basis alone. In many instances in the the past, public opinion and political action have been influenced more by the belief that an environmental problem exists than by a scientific demonstratation that it either does or does not exist (Kester et al., 1983).

## 3.5 Environmental Effects of Dredging in the Beaufort Sea

Almost all dredging activities that have occurred in the Canadian Beaufort Sea to date have been directly or indirectly related to the exploration for oil and gas. Past dredging projects have included:

(1) construction of approximately 30 artificial exploration drilling islands;

(2) construction of submerged foundation berms for ballasted drilling structures;

(3) mining of seabed sand and gravel for use in the construction of (1) and (2) above;

(4) excavation of glory holes (at drill sites) in which the blowout preventer and wellhead are placed to protect them from ice keels and pressure ridges;

(5) excavation of the McKinley Bay moorage basin where the marine fleet is overwintered;

(6) excavation of the marine approach channels to McKinley Bay and the supply bases at Tuktoyaktuk; and

(7) shorebase maintenance and artificial island maintenance and clean-up activities.

In addition to the dredging related to oil and gas activities, dredging has occurred in Tuktoyaktuk Harbour to provide construction material for a water reservoir at the Hamlet of Tuktoyaktuk (Erickson and Pett, 1981).

A summary of the potential concerns related to dredging activities in the Beaufort Sea Region is given in Table 7. Studies of environmental effects related to dredging activities in the Beaufort Sea have dealt primarily with physical and biological effects on the benthic environment (Thomas 1979; Erickson and Pett 1981; ESL 1982; Heath et al. 1982; Thomas et al. 1982; Heath and Thomas 1983; Heath and Thomas 1984; Nixon 1984; ) usually at the disposal site. Effects observed were similar to those reported in other areas where dredging occurs.

Table 9.

Summary of Potential Concerns Related to Dredging Activities in the Beaufort Sea Region (adapted from ESL 1982)

| Environmental Component or Resource | Potential or Probable Effects | Degree of Potential Regional Concern* |
|---|---|---|
| Bowhead Whales | Avoidance or attraction responses depending on degree and type of activity; localized loss of benthic food sources, and temporary interference with foraging abilities in turbidity plumes | NEGLIGIBLE for dredging per se |
| White Whales | Avoidance or attraction responses depending on degree and type activity; possible temporary interference with foraging capabilities within turbidity plumes | NEGLIGIBLE for dredging per se |
| Ringed seal | Potential avoidance or attraction responses, and temporary interference with foraging capabilities within turbidity plumes | NEGLIGIBLE |
| Bearded seal | As for ringed seal, and localized loss of benthic food sources | NEGLIGIBLE |
| Oldsquaws, eiders, loons, other diving ducks and alcids | Localized and relatively short-term loss of benthic food resources, temporary reductions in prey visibility within turbidity plumes, disturbance. | NEGLIGIBLE to MINOR: the degree of concern could be considered MINOR if dredging operations were located near "critical" feeding areas during staging and brood rearing. |

* A **MAJOR IMPACT** exists when a regional population or species may be affected to a sufficient degree to cause a decline in abundance and/or a change in distribution beyond which natural recruitment (reproduction and immigration from unaffected areas) would not likely return that regional population or species, or any population or species dependent upon it, to its former level within several generations.

A **MODERATE IMPACT** exists when a portion of a regional population may be affected to a sufficient degree to result in a change in abundance and/or distribution over more than one generation of that portion of the population or any population dependent upon it, but is unlikely to affect the integrity of any regional population as a whole.

A **MINOR IMPACT** exists when a specific group of individuals of a population in a localized area and over a short time period (one generation) may be affected, but other trophic levels are not likely to be affected in a manner which is considered regionally significant, or the integrity of the population itself is not significantly affected.

A **NEGLIGIBLE IMPACT** exists when the degree of the anticipated biological effects are less than minor.

**Table 9. cont'd.**

| Environmental Component or Resource | Potential or Probable Effects | Degree of Potential Regional Concern |
|---|---|---|
| Gulls, jaegers, shorebirds | Attraction to dredging activities due to increased availability of invertebrate food sources and/or human presence | NEGLIGIBLE |
| Marine fish | Temporary avoidance or sublethal effects (e.g. decreased feeding efficiency) resulting from exposure to suspended solids; localized loss of benthic food sources and habitat; potential entrainment of some less mobile or juvenile forms and pelagic eggs | NEGLIGIBLE to MINOR |
| Anadromous fish | Effects as with marine fish, but degree of concern is considerably greater where populations are concentrated | NEGLIGIBLE to MODERATE |
| Phytoplankton | Localized and short-term increases or decreases in growth and production associated with altered nutrient and light regimes within turbidity plumes; potential changes in local community structure during chronic or long-term disturbances | NEGLIGIBLE |
| Zooplankton | Potential mortality and sublethal effects resulting from exposure to relatively high suspended sediment levels. Increased or decreased feeding depending on concentration and nature of suspended solids | NEGLIGIBLE |

- A **MAJOR IMPACT** exists when a regional population or species may be affected to a sufficient degree to cause a decline in abundance and/or a change in distribution beyond which natural recruitment (reproduction and immigration from unaffected areas) would not likely return that regional population or species, or any population or species dependent upon it, to its former level within several generations.

  A **MODERATE IMPACT** exists when a portion of a regional population may be affected to a sufficient degree to result in a change in abundance and/or distribution over more than one generation of that portion of the population or any population dependent upon it, but is unlikely to affect the integrity of any regional population as a whole.

  A **MINOR IMPACT** exists when a specific group of individuals of a population in a localized area and over a short time period (one generation) may be affected, but other trophic levels are not likely to be affected in a manner which is considered regionally significant, or the integrity of the population itself is not significantly affected.

  A **NEGLIGIBLE IMPACT** exists when the degree of the anticipated biological effects are less than minor.

**Table 9. cont'd.**

| Environmental Component or Resource | Potential or Probable Effects | Degree of Potential Regional Concern |
|---|---|---|
| Benthic Infauna | Direct mortality due to excavation and spoil deposition in benthic habitats; habitat changes and creation of some new or unique habitats resulting in recolonization by different species; sublethal effects on feeding efficiency associated with turbidity plumes; localized effects associated with changes in water quality and sediment chemistry; entrainment of pelagic larval forms. | Variable; the degree of concern ranges from MINOR in nearshore (estuarine) zone where biomass is low to MODERATE in local sensitive and highly productive habitats. Degree of concern in offshore areas ranges from MINOR to MODERATE depending on location and size of dredging operation. |
| Benthic Epifauna | As above except for reduced degree of direct mortality due to greater mobility of some epifaunal species. Recolonization of disturbed habitat or new habitat more rapid | Variable; degree of concern ranges from NEGLIGIBLE to MODERATE depending on the location and size of dredging operations. MODERATE concern exists in some highly productive coastal environments where epifauna are important for the support of local breeding bird populations and rear-anadromous fish species. |
| Epontic Flora | Localized incorporation of suspended sediments in lower ice surface decreasing light penetration and potential production; possible short-term and localized increases in nutrient availability due to water column mixing | NEGLIGIBLE for dredging per se |

* A **MAJOR IMPACT** exists when a regional population or species may be affected to a sufficient degree to cause a decline in abundance and/or a change in distribution beyond which natural recruitment (reproduction and immigration from unaffected areas) would not likely return that regional population or species, or any population or species dependent upon it, to its former level within several generations.

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A **NEGLIGIBLE IMPACT** exists when the degree of the anticipated biological effects are less than minor.

**Table 9. cont'd.**

| Environmental Component or Resource | Potential or Probable Effects | Degree of Potential Regional Concern |
|---|---|---|
| Epontic Fauna | Altered temperature and salinity structure requiring physiological adjustment. Localized short-term decreases in oxygen availability. | NEGLIGIBLE for dredging per se |
| Micro-organisms | Possible increased numbers and metabolism of bacteria in areas where relatively high organic content or nutrient-rich sediments are excavated | NEGLIGIBLE |

* **A MAJOR IMPACT** exists when a regional population or species may be affected to a sufficient degree to cause a decline in abundance and/or a change in distribution beyond which natural recruitment (reproduction and immigration from unaffected areas) would not likely return that regional population or species, or any population or species dependent upon it, to its former level within several generations.

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A **MINOR IMPACT** exists when a specific group of individuals of a population in a localized area and over a short time period (one generation) may be affected, but other trophic levels are not likely to be affected in a manner which is considered regionally significant, or the integrity of the population itself is not significantly affected.

A **NEGLIGIBLE IMPACT** exists when the degree of the anticipated biological effects are less than minor.

# 4. MITIGATIVE TECHNIQUES

As noted in Section 3, the environmental effects of dredging and disposal of dredged material are primarily the result of increased turbidity and suspended solids in the water column, settlement of suspended and deposited material and to a lesser extent entrainment of fish due to suction currents associated with hydraulic dredges. There are few options available to limit environmental effects caused by suction currents; the most effective measures include the suspension of dredging and reduction in the rate of dredging when fish are known to occur in significant numbers near the dredge. In addition, light has been used successfully as a fish deterrent to limit the entrainment of fish at hydro power plant intakes in some instances (Balesic, 1977; Patrick, 1978, 1979, 1980; Dunstall, 1980). Several mitigative techniques are available, however, to reduce the effects due to turbidity and deposition of dredged material. Advanced technology, methods of dredge operation and strategic planning can all assist in reducing the environmental effects of dredging. The available mitigative techniques, as well as restrictions on their application in specific environments are summarized in Table 10 and discussed in detail in the following section. During the preparation of this report, considerable reluctance on the part of the dredging industry to supply specific unpublished information on mitigative technologies was encountered. This reflects the view of the dredging contractors that the development of mitigative technology is a saleable commodity which forms an important part of their competitive edge in offering dredging services. Consequently, many of the mitigative techniques contained in this table have been in use for some time and cannot be considered state-of-the-art in mitigation technology. Although the use of mitigative techniques is most relevant when the potential for substantial environmental effects is high, they are also commonly used whenever possible as part of responsible and cautious environmental management strategies even when the potential for serious environmental effects appears low. Such cautious approaches are usually taken for aesthetic reasons and to guard against possible unforeseen long-term environmental effects.

# TABLE 10.

## SUMMARY OF MITIGATIVE TECHNIQUES AVAILABLE TO REDUCE ENVIRONMENTAL EFFECTS OF DREDGING AND THEIR APPLICATION IN VARIOUS ENVIRONMENTS

| Effect | Mitigation | Environmental Application | | | Application to Beaufort Sea |
|---|---|---|---|---|---|
| | | Coastal Marine and Estuarine | Offshore Marine | Freshwater Rivers and Lakes | |
| Turbidity | Type of Dredge | | | | |
| | -Cutterhead, trailing suction | May be limited by cost, operational requirments and availability | Same as coastal marine | Same as coastal marine | Predominant dredge type in use |
| | -Clamshell-Sealed | May be limited by cost, operational requirements and availability | Same as coastal marine | Same as coastal marine | Predominant dredge type in use |
| | -Hopper-ATOS[1] | May be limited by cost, operational requirements and availability | Same as coastal marine | Same as coastal marine | Predominant dredge type in use |
| | -Special Purpose | Limited by cost, availability and productivity | Same as coastal marine | Same as coastal marine | Limited by cost, availability and productivity |
| | Operation of Dredge | | | | |
| | -Clamshell | * | Not for use in in deep water | * | * |
| | -Cutterhead | * | * | * | * |
| | Silt Curtains | May be limited by currents | * | Not for use in rivers | * Area Limitations see previous columns |
| | Chemical Coagulants | May not be necessary due to natural rates of flocculation | May not be necessary due to natural rates of flocculation | Most applicable to this environment but toxicity to aquatic organisms may limit use | May not be necessary due to natural rates of flocculation |
| | Below Surface Disposal | * | * | * | * |
| | Timing Restrictions | * | Not usually necessary | * | *Limited to coastal and estuarine areas |
| Rapid Sedimentation | Disposal Alternatives | | | | |
| | -Open water | * | * | * | *See other considerations |
| | -Open water with restrictions | * | * | * | May be applicable |
| | -Terrestrial | Not applicable | Not applicable | Not applicable | Not applicable |
| | -Intertidal | * | Not applicable | Not applicable | Not applicable |
| | -Habitat Creation | * | Not applicable | * | May be applicable |
| | Aquatic site selection | * | * | * | * |
| | Capping (only for contaminated material) | May be restricted by availability of depressions | Placement of cap at depth may not be possible | May be restricted by availability of depressions | * if required |
| | Submerged Diffuser | * | * | * | * |
| | Timing Restrictions | * | Not usually necessary | * | * |
| Entrainment of fish by suction currents | Operation of Dredge | * | Not usually necessary | * | Area limitations see previous columns |
| | Area Restrictions | * | Not usually necessary | * | Area limitations see previous columns |
| | Timing Restrictions | * | Not usually necessary | * | Area limitations see previous columns |

* = Mitigative technique applicable
1 ATOS = Anti-Turbidity Overflow System

## 4.1 Reduction of Turbidity

The reduction of turbidity and suspended solids during dredging and disposal operations is probably the most important issue associated with dredging. Environmental factors that should be considered and that may favour the use of mitigative techniques to reduce potential biological effects include: (1) significant numbers of larvae, juveniles or eggs of fish or invertebrates are present; (2) the material to be dredged is contaminated; (3) the area to be dredged is shallow or confined; (4) background levels of suspended sediments are generally well below those created by dredging; and (5) the area is important habitat for fish or invertebrates. Mitigative techniques available to reduce turbidity and suspended sediments include: (1) selection of dredge type; (2) operating techniques; (3) use of silt curtains; (4) application of chemical coagulants; and (5) below-surface disposal. If turbidity cannot be reduced by application of any of the above mitigative techniques, then timing restrictions can be considered to reduce public or environmental concerns.

### 4.1.1 Selection of Dredge

Different dredge types produce different amounts of suspended sediment in different parts of the water column. Cutterhead and hopper dredges, for example, tend to cause resuspensions that remain in the lower water column, while bucket dredges increase suspensions throughout the water column. The amount of sediment resuspension depends not only on the type of dredge used but also on the operating techniques used with the dredge. The effectiveness of this mitigative option will be limited by cost, availability and operational requirements.

#### 4.1.1.1 Cutterhead and Trailing Suction Dredges

The cutterhead and trailing suction dredges have been recommended as the dredges causing the least resuspension of sediments in the overlying water column (Raymond, 1984). (Note: Suction dredges are presently used for most dredging operations in the Beaufort Sea.)

4.1.1.2 Clamshell Dredges

In recent field investigations, the clamshell dredge caused near bottom sediment concentrations similar to those created by cutterhead dredges; however, upper water column sediment concentrations caused by the former dredge were approximately 250 percent higher than those associated with the cutterhead dredge (Raymond, 1983). Clamshell dredges that have sealed buckets create less water column turbidity than those employing unsealed buckets (Raymond, 1984).

4.1.1.3 Hopper Dredges

Hopper dredges have also caused turbidity in the upper water column, particularly in circumstances where pumping past overflow is used to maximize solids capacity (Raymond, 1984). The Japanese have developed an Anti-Turbidity Overflow System (ATOS) (Figure 7) which channels overflow to discharge ports in the bottom of the ship's hull. The system can be incorporated into existing dredges to reduce surface turbidity. It is important to note that the ATOS is effective at reducing only near-surface (< 1m) suspended solids, not the overall amount of solids in the water column.

4.1.1.4 Special Purpose Dredges

Special purpose dredges have been developed in recent years for unusual dredging projects such as dredging highly contaminated sediments. They are not usually practical for use on routine dredging projects because of their low production rates. Special purpose dredges are designed to pump dredged material slurry with a high solids content or to minimize the resuspension of sediments. The use of special purpose dredges in the Beaufort Sea will probably not be necessary because sediments containing contamination at concentrations to warrant special procedures do not exist at the present time. Nevertheless, brief descriptions of these dredges are provided below.

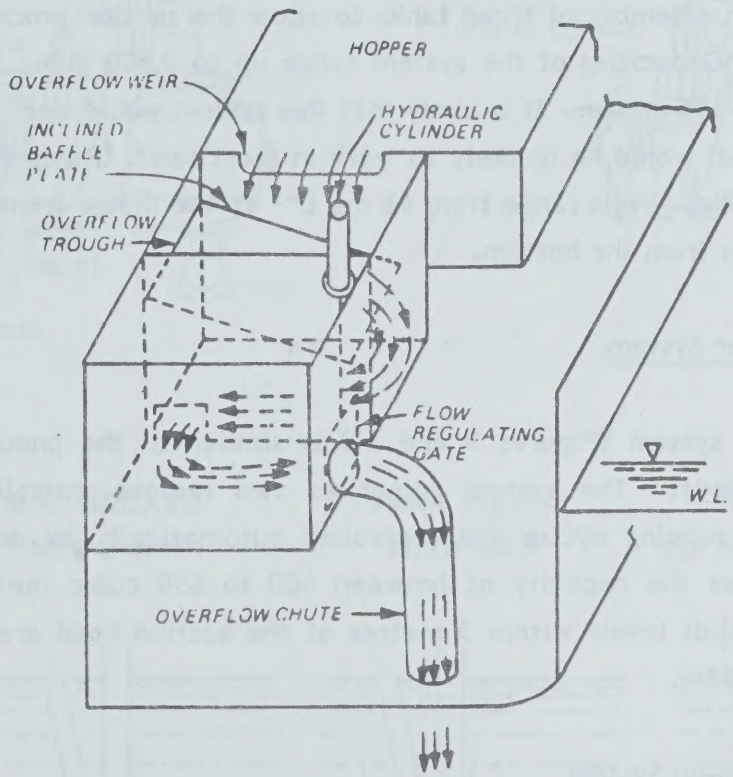



**Figure 7.** Schematic Drawing of a Hopper Dredge Bin Equipped with the Japanese Designed Anti-Turbidity Overflow System (ATOS). (after Raymond, 1984)

(a) Pneumatic Pump System ("Pneuma Pump")

This system (Figure 8) uses compressed air rather than centrifugal pumps to pump slurry from the seabed. The system can be mounted on the boom of a conventional suction dredge or can be suspended from a crane into the sediment. Once at seabed, the system agitates the sediment with a shovel and the resulting slurry is sucked into a holding tank by the static head difference betwen the tank (at surface pressure) and the seabed. Once full, the inlet valve is closed, and compressed air is used to force the slurry through a discharge pipe to the surface. The system comprises an assembly of three tanks to allow the suction process to be effectively continuous. Capacities of the system range up to 2,500 cubic metres $h^{-1}$ in water depths up to 150 metres. It is likely that this system would work well in soft cohesive sediments, but would be unlikely to work in most sands (Raymond, 1984). Measured suspended solids levels range from 48 mg $L^{-1}$ at one metre from the bottom to 4 mg $L^{-1}$ 7 metres from the bottom.

(b) Oozer System

This system (Figures 9 and 10) is similar to the pneumatic pump system described above. The system comprises two remote-controlled cylinders. The suction and purging cycles are controlled automatically by detectors in the mud tanks. It has the capacity of between 400 to 650 cubic metres $h^{-1}$. Measured suspended solids levels within 3 metres of the suction head are less than 6 mg $L^{-1}$ (Raymond, 1984).

(c) Clean-up System

This auger/pump system (Figure 11) is similar to the cutter-suction dredge, but the auger is covered by a shroud to contain the sediment suspended by the operating auger. Suspended sediment concentrations are reduced to less than 7 mg $L^{-1}$ three metres above the suction head (Raymond, 1984).

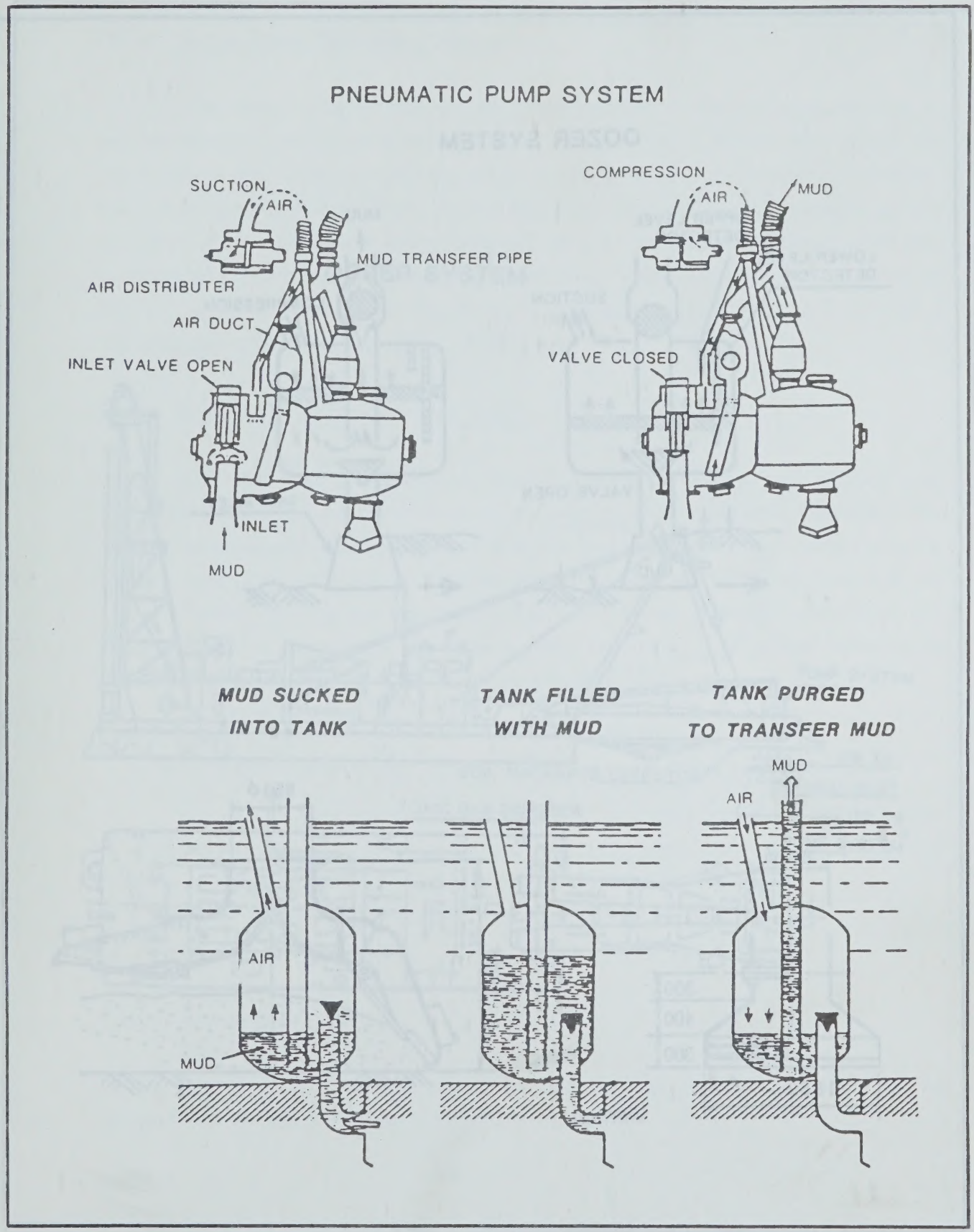



**Figure 8.** Pneumatic Pump System and its Principle (after Raymond, 1984).

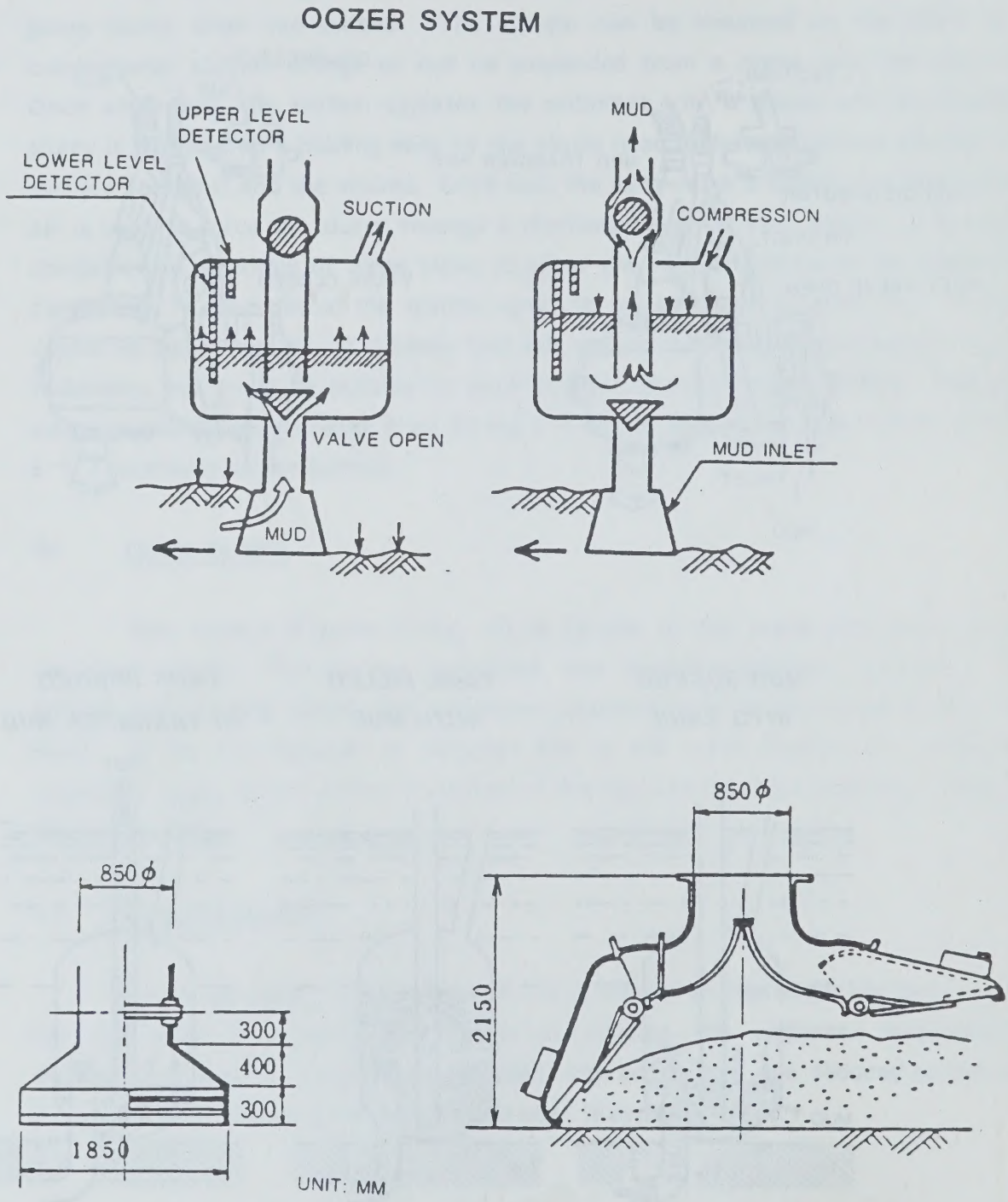



Figure 9. Oozer System and its Principle (after Sonu, 1985).

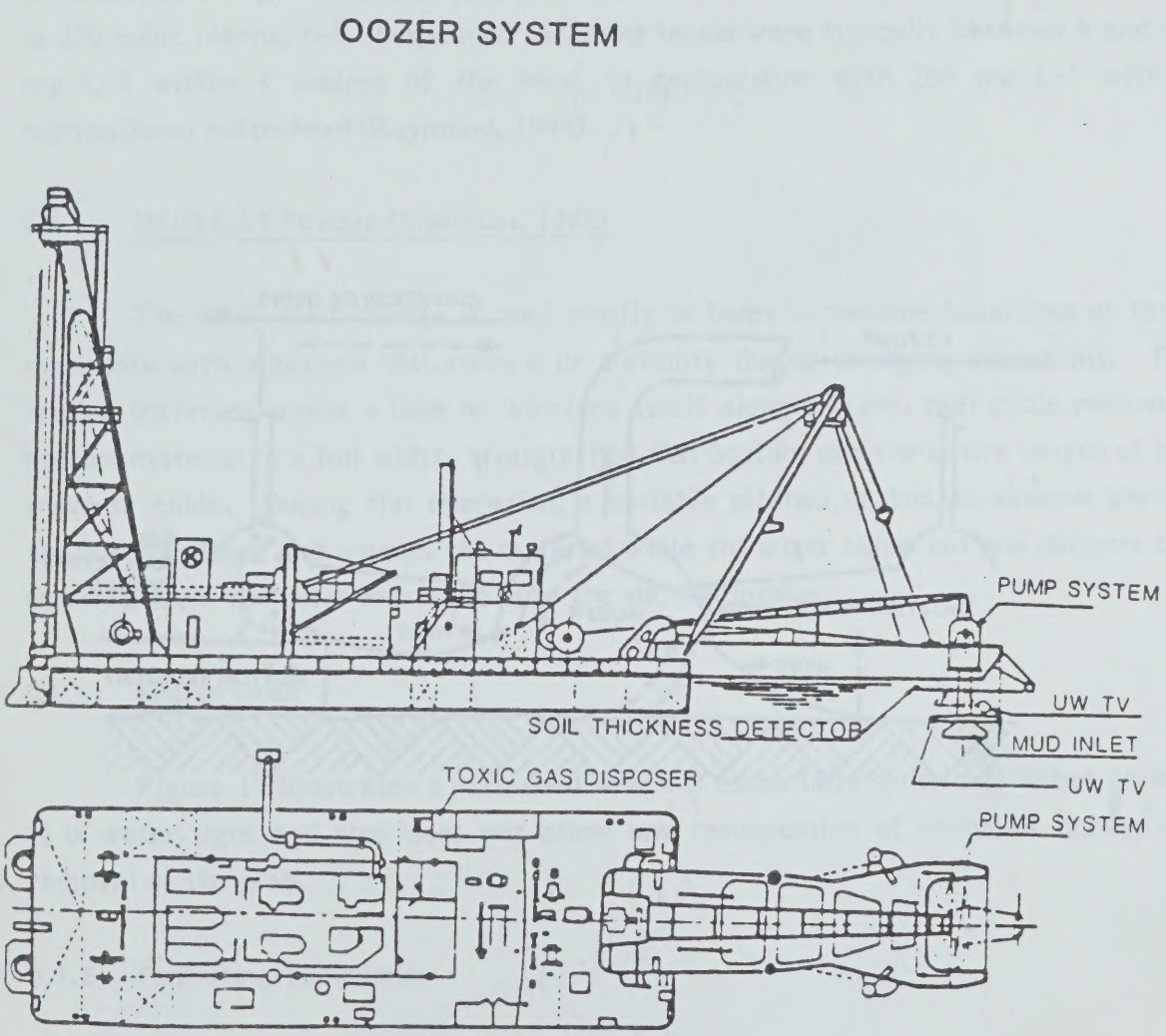



Figure 10. Oozer System Attached to a Dredge (after Sonu, 1985).

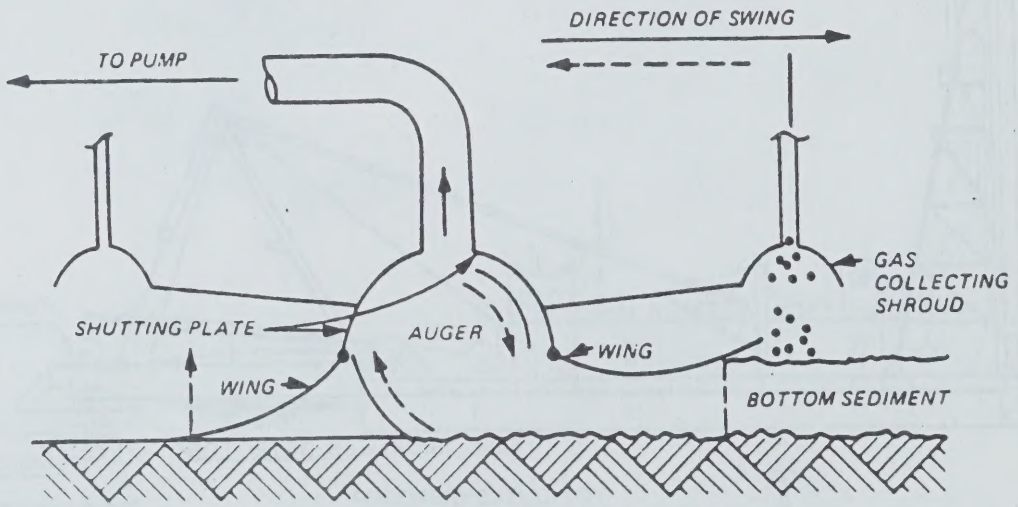



Figure 11. Clean-up System Dredgehead (after Barnard, 1978)

(d) Screw Cutter (Refresher) System

This dredge (Figure 12) is also a modification of the conventional cutter-suction dredge. The cutterhead is replaced with a rotating double helix blade, and the ladder is articulated to keep the gather blades level with the bottom. In addition, the cutter is contained in an enclosure whose sides may be opened, dependent on the direction of swing. Typical production rate for a 43 cm dredge modified in this way is 350 cubic metres $h^{-1}$. Suspended sediment levels were typically between 4 and 23 mg $L^{-1}$ within 6 metres of the head, in comparision with 200 mg $L^{-1}$ with a conventional cutterhead (Raymond, 1984).

(e) MUD CAT Dredge (Shenman, 1984)

The MUD CAT dredge is used mostly in lakes to remove hazardous or toxic materials with minimum disturbance or turbidity during dredging operations. The dredge traverses across a lake by winching itself along a fixed, taut cable removing bottom material in a full width, straight-line flat bottom cut the entire length of the traverse cable. During this operation, a variable pitched mudshield extends beyond the cutting auger and entraps the material while the auger slices out and delivers the material from the outer extremeties to the suction intake.

(f) Sealed Grab

Figure 13 illustrates a clamshell which is essentially spherical. When closed, it is water-tight and thus does not allow any resuspension of sediment during the removal of the grab.

4.1.2 Operating Techniques

4.1.2.1 Clamshell Dredge

Sweeping with buckets should be avoided and the bucket should not be dropped into the sediment when turbidity is a concern.

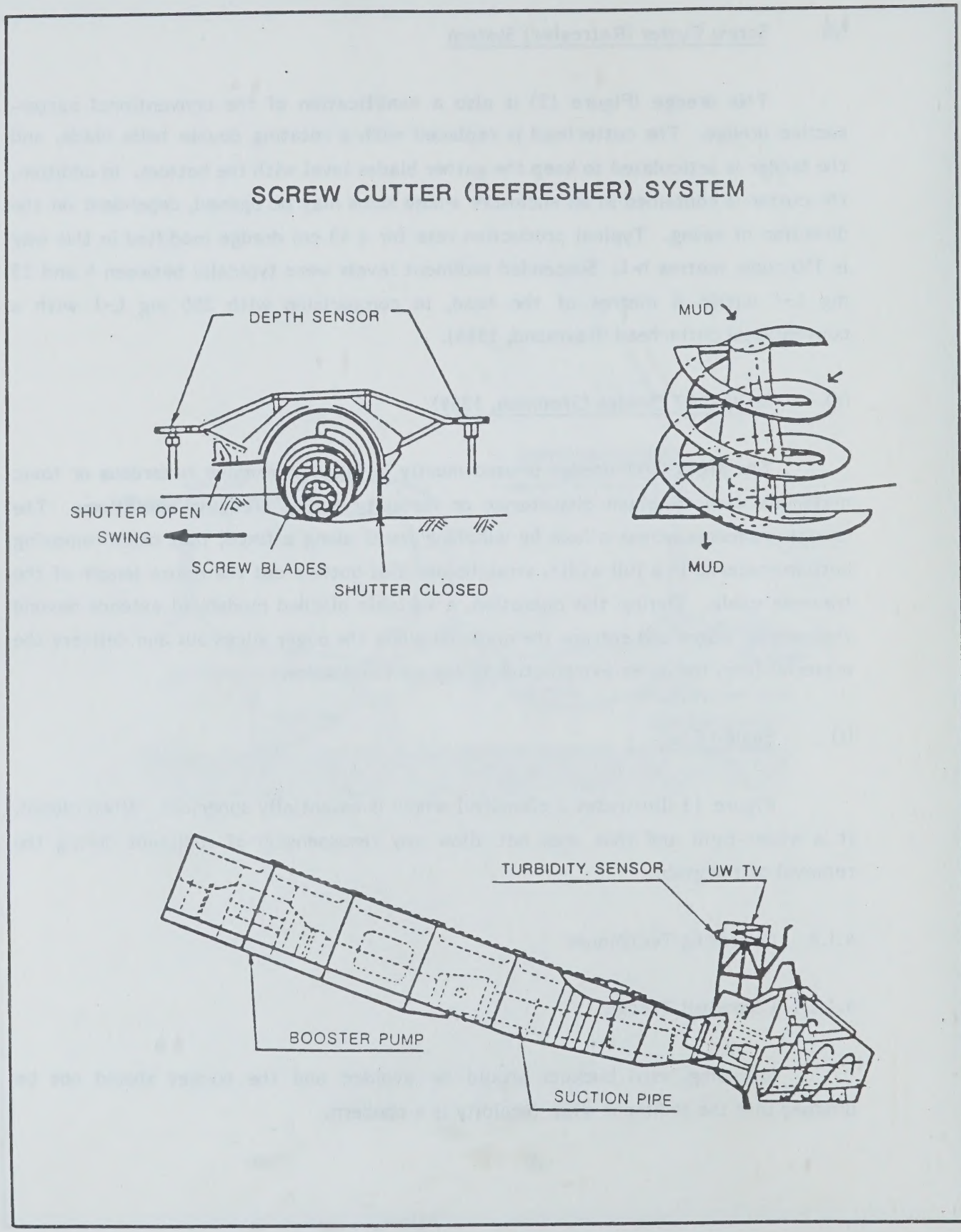



Figure 12. Screw-Cutter System (after Sonu, 1985).

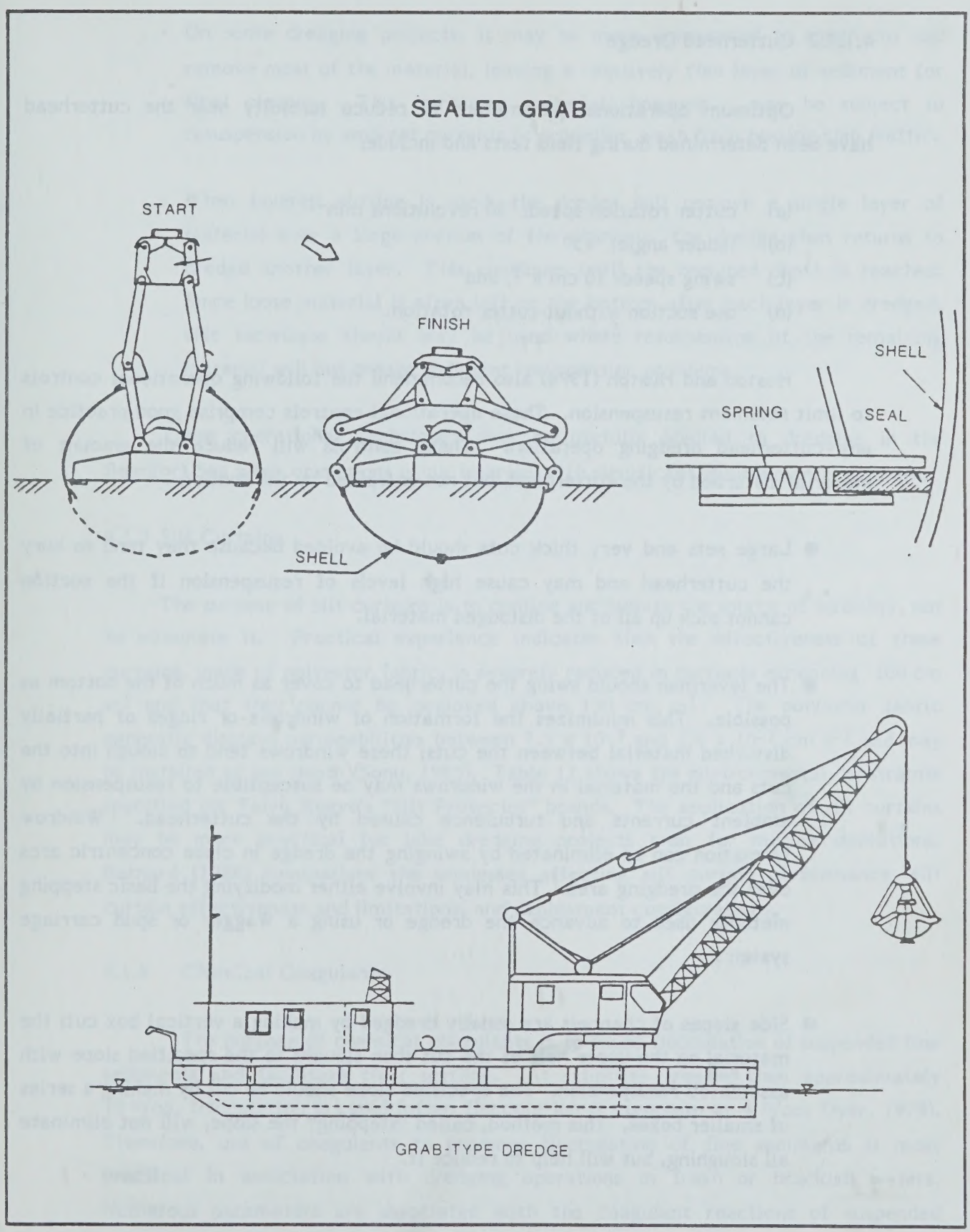



**Figure 13.** Sealed-Grab Device (after Sonu, 1985).

4.1.2.2 Cutterhead Dredge

Optimum operational parameters to reduce turbidity near the cutterhead have been determined during field tests and include:

(a) cutter rotation speed: 30 revolutions $min^{-1}$
(b) ladder angle: $45^{o}$
(c) swing speed: 10 cm $s^{-1}$, and
(d) use suction without cutter rotation.

Huston and Huston (1976) also recommend the following operational controls to limit sediment resuspension. These operational controls comprise good practice in any cutterhead dredging operation. These controls will reduce the amount of material disturbed by the cutterhead, but not entrained by the suction.

- Large sets and very thick cuts should be avoided because they tend to bury the cutterhead and may cause high levels of resuspension if the suction cannot pick up all of the dislodged material.

- The leverman should swing the cutterhead to cover as much of the bottom as possible. This minimizes the formation of windrows or ridges of partially disturbed material between the cuts; these windrows tend to slough into the cuts and the material in the windrows may be susceptible to resuspension by ambient currents and turbulence caused by the cutterhead. Windrow formation can be eliminated by swinging the dredge in close concentric arcs over the dredging area. This may involve either modifying the basic stepping methods used to advance the dredge or using a Wagger or spud carriage system.

- Side slopes of channels are usually dredged by making a vertical box cut; the material on the upper half of the cut then sloughs to the specified slope with associated resuspension. The specified slope should be cut by making a series of smaller boxes. This method, called "stepping" the slope, will not eliminate all sloughing, but will help to reduce it.

- On some dredging projects, it may be more economical to rough cut and remove most of the material, leaving a relatively thin layer of sediment for final cleanup. This remaining material, however, may be subject to resuspension by ambient currents or propellor wash from passing ship traffic.

- When layered cutting is used, the dredge will remove a single layer of material over a large portion of the channel; the dredge then returns to dredge another layer. This continues until the required depth is reached. Since loose material is often left on the bottom after each layer is dredged, this technique should only be used where resuspension of the remaining material will not create sediment resuspension problems.

These operational techniques may be usefully applied to dredging in the Beaufort Sea when operations occur in areas with significant environmental concerns.

### 4.1.3 Silt Curtains

The purpose of silt curtains is to confine and isolate the source of turbidity, not to eliminate it. Practical experience indicates that the effectiveness of these curtains, made of polyester fabric, is severely reduced in currents exceeding 100 cm $s^{-1}$ and that they cannot be deployed above 150 cm $s^{-1}$. The polyester fabric generally displays permeabilities between $7.5 \times 10^{-3}$ and $1.4 \times 10^{-2}$ cm $s^{-1}$ and may be installed at any depth (Sonu, 1985). Table 11 shows the environmental constraints specified for Taiyo Kogyo's "Silt Protector" brands. The application of silt curtains may be more practical for lake dredging projects than for marine operations. Barnard (1984) summarises the processes affecting silt curtain performance, silt curtain effectiveness and limitations, and deployment configurations.

### 4.1.4 Chemical Coagulants

The purpose of chemical coagulants is to cause flocculation of suspended fine sediments and facilitate their settling. At salinities greater than approximately 10 o/oo, flocculation is rapid (often flocculation is complete at 4 o/oo; Dyer, 1979). Therefore, use of coagulents to promote flocculation of fine sediments is most practical in association with dredging operations in fresh or brackish waters. Numerous parameters are associated with the coagulant reactions of suspended sediment, and the selection of a proper coagulant requires extensive preliminary testing.

**Table 11.**

**Environmental Conditions for Silt Curtain**
**(An Example for Taiyo Kogyo's "Silt Protector")**

| Environmental Parameters | Model A | Model B | Model C |
|---|---|---|---|
| General Condition | Exposed Location | Inland Sea, Bay and sheltered area | Lake, River, areas with no wave action |
| Max. Significant Wave Height (m) | 1.5 or above | Less than 1.5 | 0.5 |
| Design Current (cm $s^{-1}$) | 50 | 25 | 10 |
| Max. Water Depth (m) | 10 | 1 - 15 | 1 - 10 |
| Duration of Installation | 1 year or longer | Less than 1 year | 3 - 6 months |

Excerpt from Taiyo Kogyo Brochure, "Taiyo Silt Protector"

Important considerations to be taken into account in the selection process are:

(1) the quality of the water should not be affected adversely by the application of the coagulant;

(2) the chemical should be non-toxic and easy to apply and effective at as low a concentration as possible;

(3) the resulting flocs (size, hardness, fall speed, etc.) should be easy to deal with; and

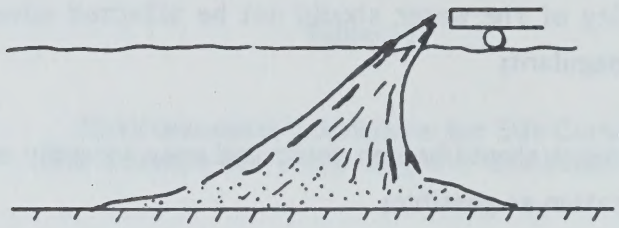
(4) the settled sediments should occupy the least amount of space.

Coagulants are currently applied at concentrations of 2-3 ppm. With good control of the application procedure, as much as 95% of the coagulants released may be removed by the suspended solids, leaving little free residue in the water column. The toxicity of chemical coagulants to shellfish, juvenile fishes and seaweed, has not been determined, and therefore, their use has been very limited to date.

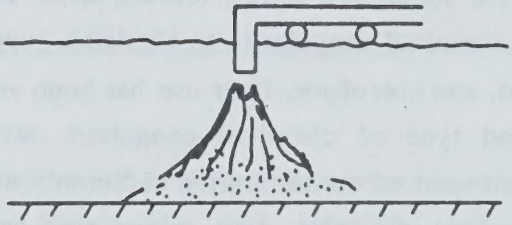
A second type of chemical coagulant developed by Japanese researchers involves the treatment of contaminated sediments with a silicic coagulant to solidify the sediment before dredging, thus minimizing any resuspension of contaminants (Oshita, 1982). The main agent of the silicic coagulant is sodium silicate which forms siloxane upon reaction with sulphuric acid. When siloxane is mixed with bottom sediment at pH 7 to 7.5 a hydrogel, which is relatively easy to remove by dredging, forms. This technique has not yet been employed, or considered necessary, in dredging operations in North America.

### 4.1.5 Below Surface Disposal of Suction Dredged Material Discharged by Pipeline

A conventional pipeline outfall and an outfall equipped with a 90o elbow are compared in Figure 14. Deloach and Waring (1984) reported that the use of an elbow extending 4.6 to 5.5 m below the water surface would cause 97 to 99 percent of the fluid mud to settle to the bottom immediately. Only one to three percent would then be available to persist in the water column in the form of a turbidity plume. A ninety-degree elbow on the discharge end of pipelines used for the discharge of suction dredged material is recommended by the U.S. Army Corp of Engineers (Montgomery pers. comm.) to limit surface suspended sediment concentrations.



CONVENTIONAL OUTFALL



OUTFALL USING 90- DEGREE ELBOW

**Figure 14.** Comparison of shapes of solid effluent mounds in still water for conventional outfall and outfall using a 90° elbow. (after Barnard, 1978).

### 4.1.6 Timing Restrictions

Lunz et al. (1984) recently summarized seasonal restrictions on dredging operations in the United States, including resources being protected and rationales for these restrictions. Following an extensive literature review of the effects of suspended solids and turbidity Lunz et al. (1984) concluded that a 500-metre buffer zone around short-term dredging operations was adequate to protect fish and shellfish resources unless contaminated sediments were present. They found that adult and subadult stages were moderately to extremely tolerant of elevated suspended sediment concentrations. In addition, they concluded that adult and subadult stages were not likely to experience sublethal adverse effects due to dredge-produced elevated sediment levels.

These conclusions suggest that timing restrictions should generally be unnecessary unless significant numbers of an important resource are concentrated in the area of the dredging operation. Timing restrictions may be applicable in the Mackenzie River estuary during the summer when white whales are present. However, restrictions would probably be due to noise and disturbance rather than turbidity.

## 4.2 Settlement and Disposal of Dredged Material

The settlement of suspended solids in the vicinity of dredging operations and the disposal of large volumes of dredged material in marine and freshwater environments has the potential to cause significant environmental effects (Table 8). Contaminated sediments present the greatest environmental concerns due to the potential for the uptake of toxic substances by aquatic organisms. Several disposal options for contaminated sediments have been developed by the U.S. Army Corps of Engineers. The approach to the ocean disposal of contaminated wastes and sediments has also been discussed in MacLaren Plansearch (1982), Great lakes Water Quality Board (1983), Kester et al. (1983), OSLO Commission (1984), and Vellinga (1984).

### 4.2.1 Selection of Appropriate Disposal Options

The U.S. Army Corps of Engineers have developed a management strategy for disposal of contaminated dredged material that includes consideration of the nature

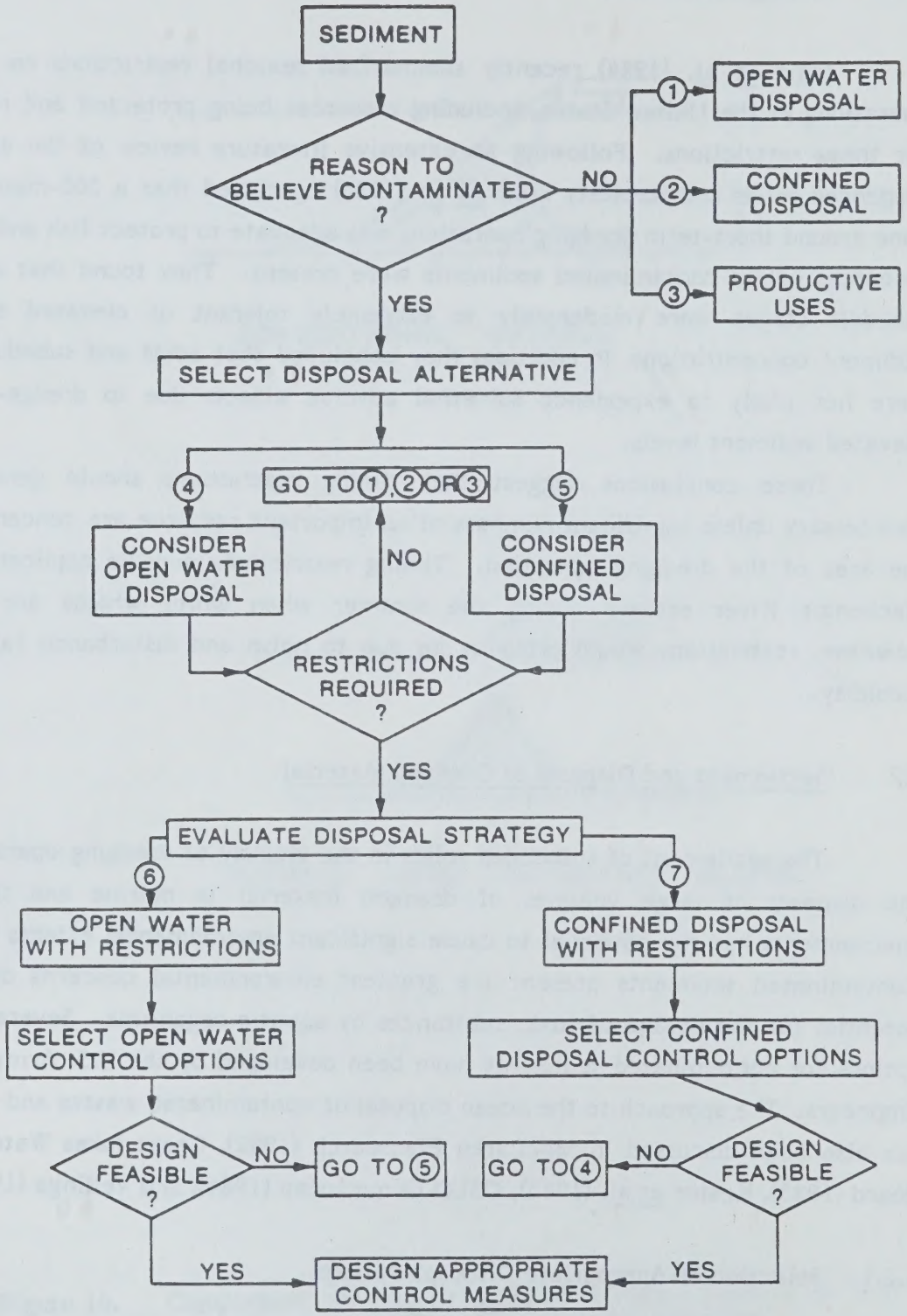



**Figure 15.** Management Strategy Flow Chart (Francingues and Palermo, 1984)

and degree of contamination, potential environmental impacts and related technical factors (Francingues and Palermo, 1984; Figure 15). The strategy includes five general disposal options: (1) open water, (2) open water with restrictions (such as capping or designated site), (3) terrestrial, (4) intertidal and (5) habitat creation (islands or marsh). Since terrestrial, intertidal and habitat creation disposal alternatives are not applicable to the Beaufort Sea at the present time, these options are not discussed in detail.

Another approach towards a detailed environmental management framework for open water disposal of contaminated material has been developed by Lee and Jones (1981, cited in Lee and Jones, 1984; Figure 16). It must be emphasised that this approach is only one of many possible. It is provided as an example, but is not particularly relevant to Canada because the elutriate test is not presently used in the regulatory process in Canada.

In addition, the U.S. Army Corps of Engineers are currently developing predictive techniques for quantifying the bioavailability of specific contaminants under different disposal conditions. These techniques will be used to determine appropriate disposal options for contaminated sediments: for example, aquatic disposal of sediments contaminated with zinc, cadmium and copper may be preferred, since these metals appear to remain relatively bound to sediments, whereas arsenic- and PCB-contaminated sediments appear to be more suited to upland disposal.

Capping of contaminated sediments with "clean" material is currently considered the most promising method of reducing contaminant availability to organisms from dredged material disposed in the aquatic environment. It is discussed below.

### 4.2.2 Site Selection

Site selection for dredging and disposal of uncontaminated materials may be necessary to avoid sensitive biological habitats, important resource use areas and other uses of the marine environment. Site selection may also include the determination of the size of disposal site necessary to contain the discharged materials. Pequegnat (1984) provides a review of factors that should be considered during selection of offshore disposal sites. Guidelines for site selection and evaluation of Great lakes Dredging Projects are given in Great Lakes Water Quality

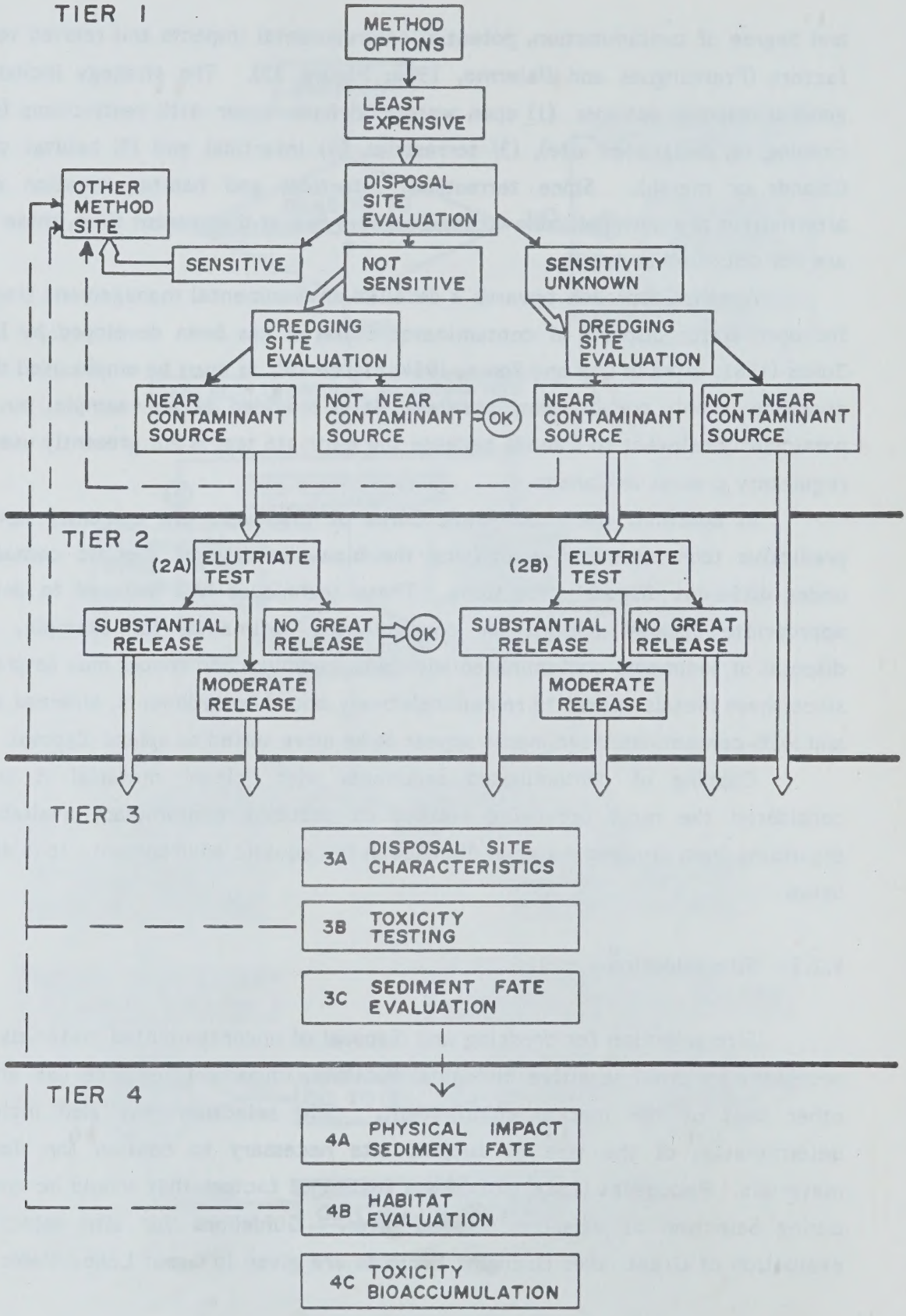



Figure 16. Diagram of Environmental Hazard Assessment for Dredged Sediment Disposal (Lee and Jones, 1984)

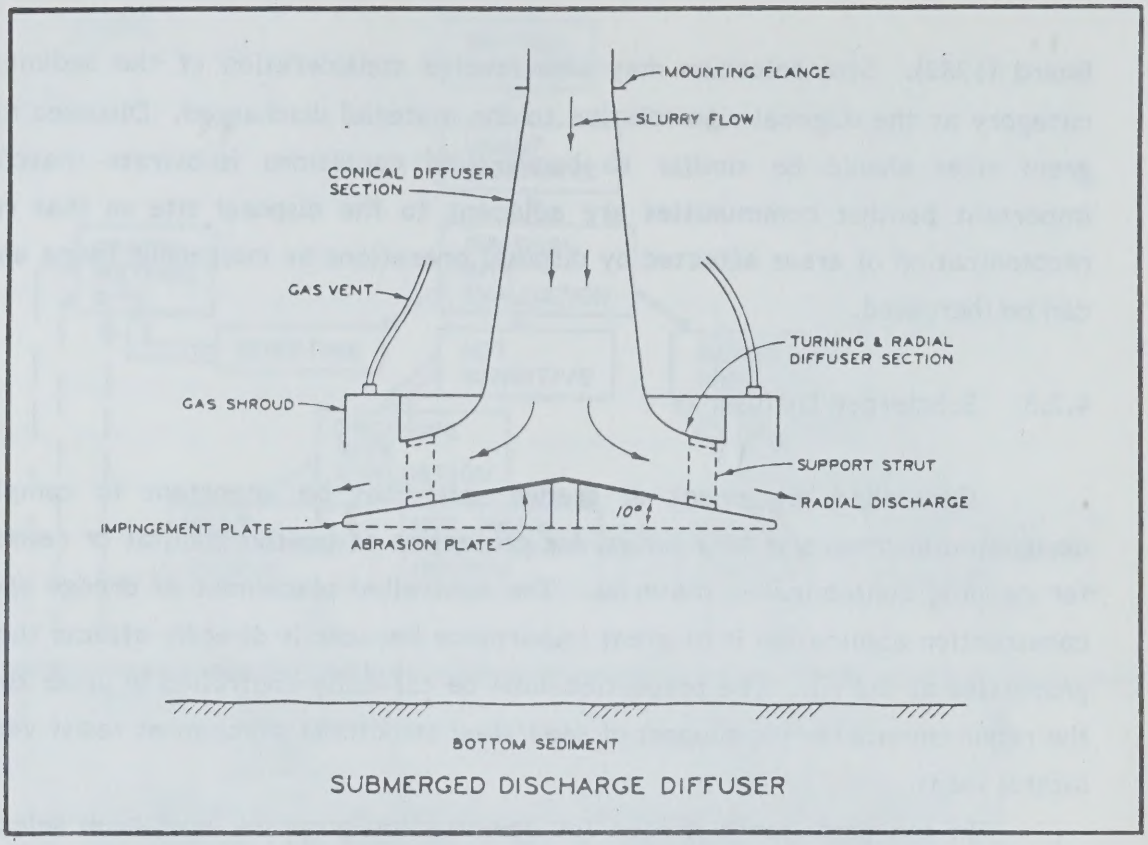
Board (1982). Site selection may also involve consideration of the sediment size category at the disposal site relative to the material discharged. Disposed material grain sizes should be similar to background conditions (substrate matching) if important benthic communities are adjacent to the disposal site so that rates of recolonization of areas affected by disposal operations by indigenous fauna and flora can be increased.

### 4.2.3 Submerged Diffuser

Controlled placement of dredge spoil may be important to comply with designated disposal site boundaries, for protection of benthic habitat or resources or for capping contaminated material. The controlled placement of dredge spoil in a construction application is of great importance because it directly affects the in situ properties of the fill. The properties must be carefully controlled in order to satisfy the requirements for the support of sand/steel structures which must resist very large lateral loads.

In the past, sands chosen for construction purposes have been selected for their low fines content. Supplies of sand suitable for the construction of artificial islands are gradually being depleted. Increasingly, therefore, sands with higher fines content will be used for construction so that sand quality improvement methods must be considered. Such methods will require the removal of fines from the sand matrix which will inevitably lead to the dumping of these fines into the water column. Such sand improvement techniques range from increased overflow from hopper dredges to the use of very large hydrocycloning equipment. Currently used construction techniques include the separation or winnowing of fines from the sand prior to placement.

The most promising equipment development related to placing dredged sediments is the submerged diffuser (Montgomery 1984; Figure 17). This system was designed by Neal et al. (1978) and was built by a Dutch dredging firm and used to place dredged material in Rotterdam Harbour in 1983. The diffuser system operates on a principle of radial divergence of flow to slow discharge velocity to acceptable levels. The diffuser could be used with existing hopper dredges, hydraulic pipeline dredges and barges with hydraulic pump-out capability (Montgomery, 1984).



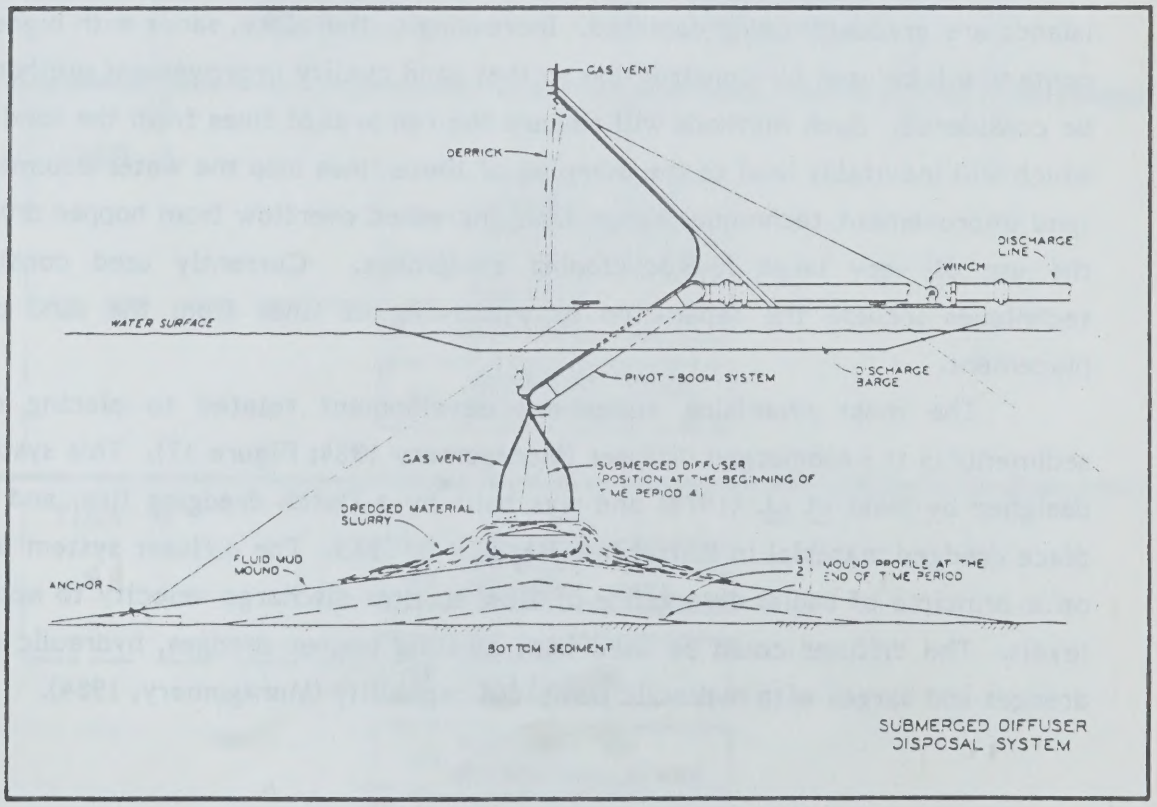




Figure 17. Top: Submerged Discharge Diffuser (after Barnard, 1978)
Bottom: Submerged Diffuser Disposal System (after Barnard, 1978)

### 4.2.4 Capping Contaminated Sediment with Clean Sand

Dredged material which is unsuitable for disposal in open water because it is considered to be contaminated has usually been placed in confined disposal areas. These areas can be on land or in the aquatic environment (containment levees, dikes and protected artificial islands (Herbich, 1981b)) and are normally expensive to construct and maintain. The method of "capping" refers to the process by which contaminated dredged material disposed in subaqueous sites may be chemically and biologically isolated from the surrounding environment by covering or "capping" it with a layer of "clean" sediment. In this way effects on the water column and long-term exposure of aquatic organisms to contaminants are largely eliminated. Gambrell et al. (1978) suggest that subaqueous capping of contaminated sediment may be environmentally superior to upland disposal.

Although the capping concept is simple, effective implementation of the concept requires solution of some challenging operational problems. Considerations for planning capping operations include: (1) dredge equipment selection; (2) selection of capping site; (3) placement method for the contaminated material; (4) method for transporting contaminated material to the disposal site; (5) selection of the capping material; (6) placement method for the cap; (7) dredge plant for obtaining cap material; (8) method for transporting cap material to the disposal site; (9) method for navigation and positioning at the cap site; and (10) method for monitoring the site. The dredge plant selected for excavating the contaminated sediments should be compatible with other project components and should minimize suspension of sediment at the dredging site and dilution of the sediment with water. Sites for capping should have characteristics conducive to long-term stability. The contaminants isolated under the cap may be mobilized if the cap erodes or if the contaminants enter the groundwater. Excavated pits and natural depressions may be particularly well suited to contain contaminated materials. Transport and placement of both contaminated and cap materials should allow for precise placement with minimal resuspension in the water column and bottom disturbance. In addition, the dredged material used for capping must be denser than the underlying contaminated material and not significantly erodible under conditions likely to occur at the site.

The capping method is currently considered the state-of-the-art in contaminated dredge material disposal methodology. Intensive research is being

conducted at the present time by the U.S. Army Corps of Engineers to evaluate the feasibility and long-term effectiveness of capping as a method to reduce the ecological impact of contaminated dredged material disposal in open water (R. Montgomery, pers. comm.). The London Dumping Convention, to which Canada is a signatory, has already accepted capping of contaminated sediments in open water disposal sites as an acceptable disposal alternative, subject to careful monitoring and research (Shields and Montgomery, 1984).

Montgomery (1984) has reviewed the existing technology regarding capping. The technique has been employed in Long Island Sound in 18 m water (Semonian, 1981); in Rotterdam Harbour (Kleinbloesem and Van der Weijde, 1983); and recently at a test site near Seattle (Sumeri, 1984). Capping has been attempted on a limited experimental basis in Ontario at a dredging project at the Port Credit Marina (Khan and Grossi, 1984). The U.S. Army Corps of Engineers is studying confined aquatic disposal and is currently investigating the feasibility of using underwater depressions to contain contaminated material in Lake Michigan (M. Palermo, pers. comm.). The technique of disposing of contaminated material in underwater depressions will result in a relatively smooth bottom contour when the cap is in place, rather than a mound which may be susceptible to erosion. Bokuniewicz (1983) has examined the potential of using submarine borrow pits as containment sites for dredged sediment; considerations discussed include the amount of dredged material that could escape from the pits during the disposal operation, form of the deposited dredged sediment, mobility of dredged sediment in the pit, thickness of cap required to isolate the dredged mud, and mechanical stability of sand caps. The feasibility of discharging dredge spoil into pits in the seabed has also been investigated in the North Sea. In mid-1983, 50,000 $m^3$ of dredged spoil was discharged into a pit in the North Sea which had a capacity of 65,000 $m^3$ (Vellinga, 1984). The behaviour of the silt in the pit was monitored, and it was found that 100 percent of the spoil was retained in the pit throughou' the monitoring period. Figures 18 and 19 illustrate capping operations using the underwater depression and mound configurations and two different placement techniques.

Studies at existing capping sites indicate that the technique is technically feasible and that the caps are stable under normal tidal and wave action (Morton, 1983; Brannon et al., 1984). Bioaccumulation studies conducted in the field have been inconclusive as to the ability of capping to prevent contaminant uptake by organisms (O'Connor and O'Connor, 1983).

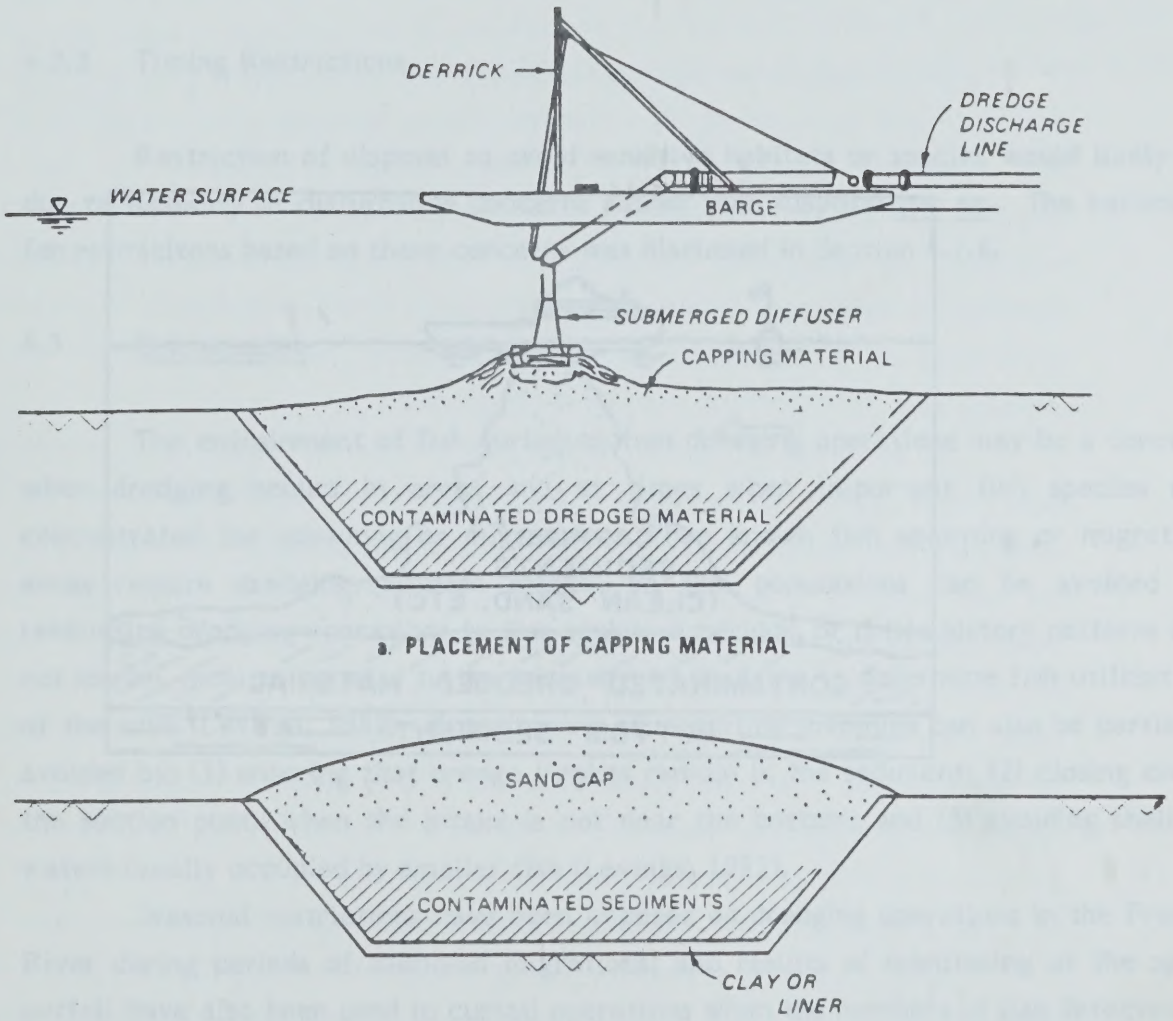



**Figure 18.** Placement of capping material on top of contaminated dredged material using submerged diffuser attached to a floating barge. (after Montgomery, 1984)

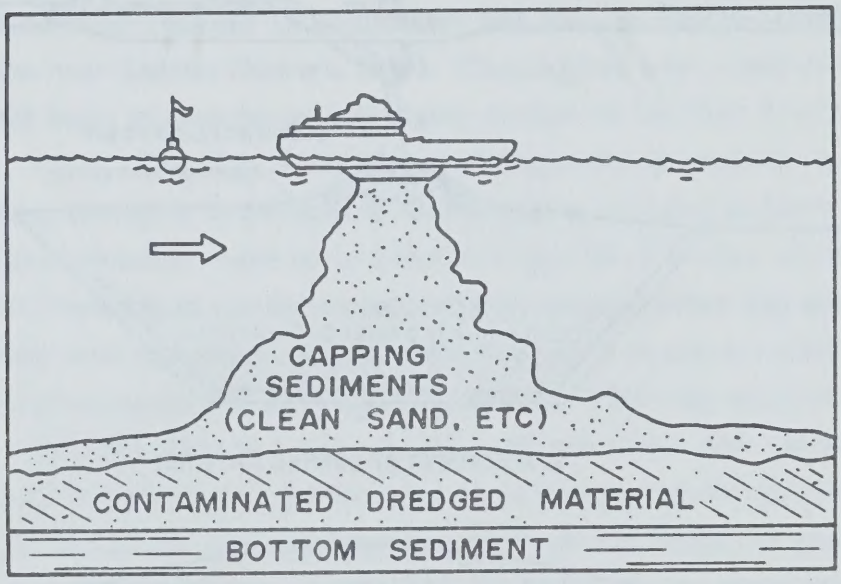



**Figure 19.** Placement of capping material on top of contaminated dredged material from floating barge.
(after Shields and Montgomery, 1984)

Capping may be a more suitable strategy for containment of contaminated dredged material in the marine environment than in lakes because the occurrence of natural depressions in lakes is generally limited. In the Beaufort Sea abandoned borrow sites and numerous natural depressions would provide potential locations for the containment of contaminated dredge spoil.

### 4.2.5 Timing Restrictions

Restriction of disposal to avoid sensitive habitats or species would likely be due to turbidity or disturbance concerns rather than disposal per se. The rationale for restricitons based on these concerns was discussed in Section 4.1.6.

## 4.3 Entrainment

The entrainment of fish during suction dredging operations may be a concern when dredging occurs in areas and at times when important fish species are concentrated for spawning or migration. When known fish spawning or migration areas require dredging, adverse effects on fish populations can be avoided by restricting dredging operations to less sensitive periods, or if life history patterns are not known, monitoring prior to the initiation of dredging to determine fish utilization of the area (Levings, 1982). Entrainment of migrating juveniles can also be partially avoided by: (1) ensuring that dredge intakes remain in the sediment; (2) closing down the suction pump when the intake is not near the bottom; and (3) avoiding shallow waters usually occupied by smaller fish (Levings, 1982).

Seasonal restrictions have been imposed on dredging operations in the Fraser River during periods of salmonid migrations, and results of monitoring at the spoil outfall have also been used to curtail operations when the numbers of fish detected in monitored spoil exceeded 10 fish per hour (or approximaely 840 fish entrained) (Tutty and Morrison, 1976). The availability of adequate techniques to determine fish entrainment from large capacity suction dredges has been questioned (Pelletier and Wilson, 1981; cited in Levings, 1982), and therefore the basis for restrictions should also include life history and site-specific information.

In conclusion, mitigation in the form of timing or area restrictions for large capacity suction dredging operations, due to concerns regarding entrainment of fish

may be warranted when dredging occurs in a restricted area and coincides with use of the area by large numbers of fish, or when an area is known to be important for fish spawning.

## 4.4 Application of Mitigative Technologies to Arctic Waters

Techniques currently used to mitigate the environmental impact of dredging can be placed into one of the following four categories: (1) operational procedures that minimize dredge-generated turbidity (e.g., optimization of cutter speed, stripping and excavation methods, dredging of "cleaner" soils and minimizing hopper overflow); (2) equipment modifications that minimize turbidity generation (e.g., shrouded or shuttered cutters and anti-turbidity overflow system); (3) development of novel excavating techniques (e.g., pneuma pump and oozer); and (4) containment methods (e.g., silt curtains and use of coagulants).

To date, all mitigation categories except for operational procedures have been implemented on a small scale, relative to typical Beaufort Sea dredging operations and equipment, or are only suitable in specific situations. For example, the anti-turbidity overflow system has only been employed on dredges with hopper capacities between 150 and 750 cubic metres. Typical hopper dredgers operating in the Canadian Beaufort Sea have hopper capacities that range from 6,000 to 9,000 cubic metres, an average 15-fold increase in capacity over current ATOS-equipped hopper dredges. A similar disparity exists between cutter suction dredges. Typical cutter suction dredges employed in Beaufort Sea construction activities remove cohesive material at a rate of about 2,000 cubic metres per hour; currently available shrouded or skirted cutters have capacities of less than 500 cubic metres per hour.

Novel dredging systems, such as the pneuma pump (2,500 cubic metres per hour) and the oozer system (650 cubic metres per hour) might be logical alternatives for Beaufort Sea service; however, due to the nature of the excavation method, they are restricted to operating in soft cohesive sediments. It is reported that the systems would not be appropriate for dredging stiff sediments or cohesionless soils such as sand. Since the latter two soil types are prominent in the current area of Beaufort Sea activity, the likelihood of deploying these systems in the Beaufort region is low.

Containment techniques are appropriate for small-scale applications; it appears, however, that large scale application of either alternative in deep, often rough water is currently an unproven technology. As well, the impact of chemical coagulants in the environment is not fully understood.

In summary, while various methods of reducing turbidity are available the only technique that is readily adaptable to dredges operating in the Beaufort Sea is operational procedures which involve structuring operations in order to limit the resuspension of silts and clays. This is accomplished by controlling cutter speed and movement to a greater degree, precise pit excavation techniques, minimal overflowing of hoppers, and if possible, by not dredging sediment with a high silt or clay content. These mitigation measures have been used on a limited but routine basis by current operators in the Beaufort Sea.

## 5. STATE-OF-THE-ART RESEARCH INTO THE BIOLOGICAL EFFECTS OF DREDGING AND MITIGATIVE TECHNOLOGIES BY THE U.S. ARMY CORPS OF ENGINEERS

Much of the recent research into the environmental effects of dredging and dredge spoil disposal has been conducted in the United States by the U.S. Army Corps of Engineers. This group has systematically studied the potential effects of dredging in different marine coastal, deep ocean and freshwater environments for the past two decades. Although other countries have made important contributions to the understanding of the environmental implications of dredging and dredge spoil disposal, none have consistently directed as much human and financial resources to the subject as has the United States. Overall, the state-of-the-art research into the biological effects of dredging and mitigative technologies tends to reside with the U.S. Army Corps of Engineers. Consequently, a summary of some of the current research programmes being conducted by the Corps is outlined below.

The U.S. Army Corp of Engineers has recently initiated a series of six-year research programmes to develop methodologies for planning long-term disposal strategies for contaminated dredged material that will minimize adverse environmental effects (Lazor et al., N.D.). The major programs include: (1) investigation of the implications of bioaccumulation in aquatic organisms for the development of regulatory criteria; (2) development of predictive methodologies regarding long-term environmental effects of dredged material disposal; (3) investigation of innovative technologies to reduce environmental effects associated with dredged material disposal and to a lesser extent those associated with dredging; and (4) verification of established predictive capabilities regarding the environmental effects of different disposal options.

Research in the area of aquatic systems is concentrated on the linking of sediment concentrations of PCB's and trace metals with body burdens and physiological effects in aquatic organisms. The objective of this work is to establish reproducable methodologies to determine the potential for bioaccumulation and defensible criteria for determining significant biological effects. Researchers are currently investigating the reproductive process as the most likely index for regulatory guidelines toward defining adverse effects on aquatic organisms.

Technological studies are currently focussed on the definition of the operational aspects of capping, including: (a) modelling for prediction of settlement of dredged materials, and (b) management plans for long-term monitoring and

evaluations for cap integrity. Some studies are planned for dredging techniques and unconventional equipment used for "highly contaminated sediments". Although these studies are not a priority at the present time, their objective will be to develop guidelines for dredging operations involving highly contaminated sediments (Lazor et al., N.D.).

The main research programmes currently underway are (1) the Long-Term Effects of Dredging Operations (LEDO) Programme, (2) the Field Verification Programme (FVP) and (3) Improvement of Operations and Maintenance (IOMT) Programme: Dredging Contaminated Sediment Section. These programmes are described in detail below.

## 5.1 Long-Term Effects of Dredging Operations Programme (LEDO)

The objectives of LEDO are to provide new or improved state-of-the-art technology for predicting long-term environmental impacts of dredging operations and to improve or develop methods for minimizing any adverse impacts associated with dredged material disposal. Work is currently being conducted to determine the effects of aquatic disposal and the effects of terrestrial disposal. LEDO is planned as a continuing programme since applied environmental research must address current problems and research priorities are subject to change.

General specific areas of research in LEDO include the following:

a) Bioaccumulation (uptake) and biomagnification (transfer) in the aquatic environment including interpretation.

Establish the significance of bioaccumulation and biomagnifications in aquatic organisms of contaminants associated with the aquatic disposal of dredged material and develop or improve predictive techniques for estimating the potential bioaccumulation of chemicals from sediments.

b) Development and assessment of procedures to reduce any adverse impacts.

Laboratory and field test existing procedures that will eliminate or minimize adverse impacts of dredged material disposal. Capping of contaminated dredged material with clean dredged material is an example of an innovative procedure which the London Dumping Convention allows, provided continuing research is conducted.

c) Upland plant and animal bioassay procedures.

Improve first-generation plant and animal bioassays for predicting uptake of contaminants in wetland and upland disposal areas.

d) Effluent quality.

Increase the understanding of the geochemical changes that occur with time in upland dredged material containment areas; develop or improve techniques for predicting contaminant concentrations in the effluent from diked dredged material containment area. The development of mixing zone technology is also included in this work.

Study results will provide a much broadened state-of-the-art technical basis for the Corps' implementation of its environmental responsibilities under Federal legislation. Specifically, technically updating the Ocean Dumping Implementation Manual and providing a Section 404 Clean Water Act implementation manual are program objectives. Emphasis will be placed on presenting research results in the domestic and international technical and scientific literature as well as making results immediately available to the field through normal Corps channels.

## 5.2 Field Verification Programme (FVP)

During planning of LEDO field studies with the Corps' New England Division, it became apparent that a unique set of circumstances existed in the New England region of the United States where three disposal alternatives could be evaluated at the same time (open-water disposal, upland disposal, and wetland creation). The FVP was established as a cooperative effort between the Corps' New England Division, WES, and EPA to field-verify existing predictive testing procedures. Through the program, promising procedures already developed by the Corps along with techniques developed by EPA for nondredged material will be applied to project conditions at Black Rock Harbour, Bridgeport, Connecticut, using dredged material from a single maintenance dredging operation Although the three disposal alternatives have been evaluated independently during the DMRP, these field studies will provide the first opportunity for direct comparison of the environmental consequences using the same dredged material under different disposal conditions.

The major areas of investigation of this programme include:

a) Bioaccumulation of contaminants by aquatic anaimals.

Levels of bioaccumulation of selected contaminants over time, biological and physical factors affecting bioaccumulation, and variability of bioaccumulation predictions will be documented in the laboratory. Bioaccumulation will then be determined under field conditions and compared to laboratory predictions to verify the accuracy of the prediction methods.

b) Consequences of bioaccumulation in aquatic animals.

Physiological indices of biological health will be assessed in organisms that have accumulated contaminants from dredged material. These indices, previously developed by EPA for use in nondredged material regulatory programmes, will include scope for growth, sister chromatic exchange reproductive effects, effects on enzyme systems, and histopathological parameters. The responses of aquatic animals to contaminants are being determined in the laboratory to establish feasibility for assessing dredged material and correlation with bioaccumulation. Responses will then be verified in aquatic organisms exposed to contaminated sediments in the field.

c) Effects of aquatic disposal on community structures.

Effects of contaminated dredged material disposal on community structures are being determined by measuring mortality, reproduction, and intrinsic rate of growth in selected populations within aquatic communities. The assessments will be documented in the laboratory and verified by monitoring in the field.

d) Effects of upland disposal on water quality.

Laboratory tests for predicting effluent quality will be conducted on contaminated sediment prior to placement in a confined disposal area. The confined disposal area was designed, operated, and managed to ensure optimum fill configuration for the field studies and evaluation of effluent quality effects. During filling operations, influent and effluent water quality parameters have been

monitored extensively at selected stations within the disposal area. Following disposal, the quality of surface water runoff is being determined by collecting surface water samples from controlled simulation of rainfall. Monitoring wells have been placed around and within the disposal area, and groundwater samples taken before, during, and after filling.

e) Bioaccumulation of contaminants in upland and wetland plants.

First-generation test procedures from DOTS (Dredging Operations Technical Support Programme) and other studies will be verified at the field site. Saltmarsh plants have been grown under controlled wetland and upland conditions and analysed for contaminant bioaccumulation. Field tests will be conducted to verify laboratory test results. Saltmarsh plants will be planted at the upland disposal facility at Black Rock Harbour and sampled each growing season to determine contaminant bioaccumulation.

f) Bioaccumulation of contaminants in upland and wetland animals.

Existing upland and wetland animal bioassay test procedures developed in Europe will be verified in the field using selected upland and wetland animals.

Results of the FVP will provide both the Corps and EPA with documented and verified state-of-the-art procedures and interpretative guidance for complying with national regulatory requirements and international conventions and agreements. The FVP study is scheduled to be completed in six years.

## 6. CONCLUSIONS AND RECOMMENDATIONS

1. Additional effort in compiling information on the environmental effects of dredging and dredge spoil disposal operations in the Canadian Beaufort Sea does not appear to be warranted at the present time. Sufficient information and experience are currently available from other parts of Canada and other countries to indicate that, with the exception of areas of special sensitivity, consequential environmental effects associated with the dredging and disposal of uncontaminated dredge spoils are highly unlikely. The dredging and disposal of contaminated sediments, on the other hand, are areas of considerable environmental concern. At the present time, however, it should be sufficient for the regulatory agencies in Canada to monitor the progress of other countries, such as the United States and Japan, in dealing with the existing dredging and disposal of contaminated sediments in aquatic environments. In the event that Beaufort Sea sediments become contaminated in the future and that dredging and disposal of these sediments becomes necessary, the most up-to-date technology and techniques could then be applied to the problem.

2. Although mitigative technologies exist for offshore dredging and disposal operations, they have been built on a small scale and project-specific basis. In general, most of these technologies such as silt curtains and chemical coagulants are infeasible in the Beaufort Sea. Furthermore, they are unnecessary at the present time. The approaches to mitigation most applicable to the Beaufort Sea are operational ones such as controlling cutter speed and movement to limit turbidity generation during dredging and the imposition of timing or area restrictions to reduce the habitat disturbances at sensitive times or locations.

3. Selection of dredge excavation and disposal sites should be conducted in a manner which avoids sensitive marine habitats and uses. This operational approach has been used in many regions as a mitigative strategy to avoid or minimize adverse environmental effects. The assessment of specific applications for dredging permits could be assisted by the availability of a map series that delineates potential dredge excavation and disposal sites and

describes their relative environmental sensitivity. These maps should place greatest priority on areas identified by industry as having the highest potential for future dredging operations and should identify environmental sensitivity in terms of the habitat and populations of all trophic levels. Dredging sites in the nearshore zone should be emphasized during the sensitivity mapping because of: (1) the potential for very shallow nearshore alterations in seafloor contours to locally change water circulation patterns and the T/S characteristics of the water column; and (2) the expected importance of inshore areas as feeding, rearing and in some species, overwintering habitat for several anadromous species of fishes. In addition, this nearshore zone is an important migration corridor for fish at some times of the year.

The recommended sensitivity maps should use information contained in the DFO data inventory series to the extent possible, as well as data collected during past and ongoing studies by or on behalf of all government agencies and petroleum industry operators in the Beaufort region. The utility of the maps should also be maximized through a periodic updating process as new environmental information becomes available or changes in the development scenario for the region suggest that other sites of dredging or spoil deposition may be necessary. It is also emphasized that information contained in the recommended sensitivity map series may be of substantial value for other purposes unrelated to dredging, including the identification of areas requiring priority protection/cleanup in the event of oil spills in the region.

4. Effort should be directed at expanding the definition "contaminated" sediment to include substances in addition to Hg, Cd, PCBs and "oil and grease". Ideally, the concentrations used as criteria for "contaminated" should bear some relationship to biological availability and biological effect.

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# APPENDIX A

## DIRECTORY OF GLOBAL DREDGING FLEETS

(Source: World Dredging and Marine Construction Magazine, March 1984)

## DIRECTORY OF DREDGE FLEETS

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# DREDGE LEGEND

Suction Systems:

TH — Trailing Suction Hopper
SH — Suction Hopper
CS — Cutter Suction
S — Suction
SD — Suction Dustpan

Bucket Systems:

BL — Bucket Ladder
BG/BC — Floating Grab/Clamshell
BD — Bucket Dipper
GH — Grab Hopper
BB — Bucket Backhoe

Special:
BWS — Bucket Wheel Systems
M — Mining

TH

SH

GH

CS

BD

BL

BG
BC

## ALBANIA

**Government of The People's Socialist Republic of Albania, Durres**

| | | | |
|---|---|---|---|
| "Rodon" | — | — | BG |

## ARGENTINA

**Barufaldi Hnos., (Silos Areneros Buenos Aires S.A.C.), Calle Pedro de Mendoza 905, Buenos Aires**

| | | | |
|---|---|---|---|
| "Eligio B." | — | 490 hp | S |

**Direccion Nacional de Construcciones Portuarias y Vias Navegables, 5° Piso Avenida Julio A Roca 734-738, 1067 Buenos Aires**

| | | | |
|---|---|---|---|
| "Buenos Aires 257-C" | 2,483 cu. m. | 9,720 hp | TH |
| "Cordoba 261-C" | 2,483 cu. m. | 5,041 hp | TH |
| "Mendoza 259-C" | 2,483 cu. m. | 9,720 hp | TH |
| "Santa Cruz 260-C" | 2,483 cu. m. | 9,720 hp | TH |
| "Santa Fe 258-C" | 2,483 cu. m. | 9,720 hp | TH |
| "Tierra Del Fuego 150-C" | | | |
| "332-C Missiones" | — | — | CS |
| "34-C Formosa" | — | — | — |
| "35-C Chaco" | — | — | — |
| "36-C Chubut" | — | — | — |
| "37-C Rio Negro" | — | — | — |
| "42-C Entre Rios" | — | 2,859 hp | TH |
| "43-C Corrientes" | — | 2,859 hp | TH |

**Dragados y Obras Portuarias, Olazabal 2877, 1428 Buenos Aires**

| | | | |
|---|---|---|---|
| "Maria Ana" | 33 in. | 8,115 hp | CS |
| "Nueve" | 30 in. | 7,239 hp | CS |
| "211" | 24 in. | 2,311 hp | CS |
| "210" | 24 in. | 2,311 hp | CS |

**Pagliettini S.A., Constitucion 2600, (1646) San Fernando, Pcia. Bs. As.**

| | | | |
|---|---|---|---|
| "Chapaleo II" | 16 in. | 865 hp | CS |
| "Chapaleo" | 12 in. | 450 hp | CS |

**S.A. Angel Cassanello Ltda., Calle San Luis 3000, Santa Fe**

| | | | |
|---|---|---|---|
| "Mediterraneo" | — | — | S |

**Secretaria de Estado de Obras Publicas, 3° Piso, Avenida Corrientes 389, Buenos Aires**

| | | | |
|---|---|---|---|
| "M.O.P. 28-C Stella Maris" | | | |
| "M.O.P. 223-C | 1,144 cu. m. | — | CS |
| "M.O.P. 224-C" | — | — | CS |
| "M.O.P. 228-C" | 2,000 cu. m. | 4,480 hp | TH |
| "252-C" | — | — | TH |
| "253-C" | — | — | TH |
| "254-C" | — | — | TH |
| "256-C" | 6,000 cu. m. | 4,200 hp | TH |

**Silos Areneros, Pedro de Mendoza 905, Buenos Aires**

| | | | |
|---|---|---|---|
| "Dona Nina" | — | 2,080 hp | S |
| "Potenza" | — | 2,080 hp | TH |

## AUSTRALIA

**Australian Dredging and General Works Pty. Limited, 409 St. Kilda Road, Melbourne, Victoria, 3004**

| | | | |
|---|---|---|---|
| "A.D. Geopotes I" | 3,000 cu. m. | 7,700 hp | TH |
| "A.D. Australia" | 850 mm | 9,032 hp | CS |
| "Crocodile" | 510 mm | 2,690 hp | CS |

This company, formed in 1950, is a wholly-owned subsidiary of Royal Volker Stevin N.V. of The Netherlands. Their activities center on dredging and reclamation works, associated marine works, slope protection and breakwater works, hydrographic surveying and offshore site works, and offshore drilling and blasting.

Company personnel are:
H.A. Evers—managing director;
Capt. P.S. Wickham—marine superintendent;
C.J. Robbins—secretary;
H.G. Pike—contracts manager;
R.D. Wilkinson—chief engineer.

**Bema Investments Pty. Ltd., 42A Algermon St., Oatley, 2223**

| | | | |
|---|---|---|---|
| "Couloir" | 10 x 12 in. | 540 hp | CS |
| "K.M.C." | 8 in. | 390 hp | CS |
| "S.S." | 8 in. | 350 hp | CS |
| "Kyle Twin" | 6 in. | 400 hp | S |

**Brisbane Authority, Port of, G.P.O. 1818, Brisbane, 4001**

| | | | |
|---|---|---|---|
| "Sir Thomas Hiley" | 3,000 cu. yds. | 7,500 hp | TH |
| "Echeneis" | 1,054 cu. yds. | 1,410 hp | TH |
| "Saurian" | 16 in. | 765 hp | CS |
| "Tridacna" | 3 cu. yds. | 125 hp | BG |

**Bundaberg Harbour Board, 9 Quay Street, Bundaberg,Queensland 4670**

| | | | |
|---|---|---|---|
| "Ceratodus" | 16 in. | 900 hp | CS |
| "BHB No. 4" | 3 tons | 150 hp | BG |

**Cockburn Cement Ltd., Russell Road, South Coogee, Perth, West Australia**

| | | | |
|---|---|---|---|
| "Success" | — | — | CS |

**W. Davidson P/L, 27 Bennelong Rd., Homebush Bay, N.S.W. 2140**

| | | | |
|---|---|---|---|
| "Davidson No. 7" | 12 in. | 470 hp | CS |
| "Davidson No. 6" | 10 in. | 350 hp | CS |
| "Davidson No. 10" | 10 in. | 350 hp | CS |
| "Davidson No. 5" | 10 in. | 400 hp | S |
| "Davidson No. 8" | 10 in. | 450 hp | S |
| "John W" | 14 in. | 750 hp | CS |
| "Andrew D" | 14 in. | 750 hp | CS |

**Derwent Tug Co. Pty. Ltd., 73 Murray Street, Hobart, Tasmania, 7000**

| | | | |
|---|---|---|---|
| "William Cowper" | — | — | SH |

**Duncan & Russell Pty., Ltd., 7 Dahlenburg St., Footscray, Vic. 3011, Tel.: 68 3847**

| | | | |
|---|---|---|---|
| "Tatura" | 12 in. | 985 hp | CS |
| "Eva Kathleen" | 8 in. | 200 hp | CS |
| "Pneuma 1." | 360 type | | S |
| "Pneuma 2." | 360 type | | S |

**Kleensands Pty. Ltd., 28 Meredith Street, Bankstown, N.S.W. 2200**

| | | | |
|---|---|---|---|
| "Sand Groper" | 6-8 in. | 160 hp | S/M |
| "Sand Miner" | 10-8 in. | 350 hp | CS/M |

**Launceston Authority, Port of, P.O. Box 257c, Launceston, Tasmania 7250**

| | | | |
|---|---|---|---|
| "Currong" | 180 cu. yds. | 160 hp | CS |
| "Priestman Grab" | 75 cu. yds. | — | BG |

**Macare Reclamations Pty. Ltd., 28 Meredith St., Bankstown, N.S.W. 2200**

| | | | |
|---|---|---|---|
| "Dredgequick No. 10" | 10-12 in. | 800 hp | CS |
| "Channel Cutter No. 13" | 10-8 in. | 560 hp | CS |
| "Macare No. 14" | 6-8 in. | 180 hp | CS |
| "Macare No. 7" | 6-8 in. | 195 hp | CS |
| "Macare No. 11" | 10-12 in. | 420 hp | S |

**Maritime Services Board of New South Wales, Box 32, G.P.O. Sydney, N.S.W. 2001**

| | | | |
|---|---|---|---|
| "E.O.K. Green" | 18,000 cu. ft. | 1,800 hp | BG |
| "Pandalla" | — | — | BG |

**Port of Devonport Authority, 50 Formby Rd., Devonport, Tasmania 7310**

| | | | |
|---|---|---|---|
| "Port Frederick" | 350 mm | 1,540 hp | S |

Types of Work Performed:
Port Operations;
Cold Storage Operations;
Operation of the local Devonport Airport.

Company officials are:
Dallas J. Cowan—general manager;
Noel T. Johnson—secretary;
Capt. W.J. Stuart—harbor master.

**Port of Melbourne Authority, P.O. Box 4721, Melbourne, Victoria 3001, Telex: 34211, Tel.: (03) 6111777**

| | | | |
|---|---|---|---|
| "A.S. Mayne" | 28 cu. ft. | 1,000 hp | BL |
| "A.D. Mackenzie" | 28 cu. ft. | 400 hp | BL |
| "No. 29" | 6½ tons | 110 hp | BG |
| "No. 89" | 6½ tons | 110 hp | BG |

**Public Works Dept., 2 Treasury Place, Melbourne, Victoria 3002**

| | | | |
|---|---|---|---|
| "Matthew Flinders" | 1,200 cu. yds. | — | TH |
| "Sandpiper" | 12 in. | — | CS |
| "Cormorant" | 8 in. | — | CS |
| "April Hamer" | side caster | — | S |
| "Paynesville" | 12 in. | — | S |
| "Gannet" | 8 in. | — | S |
| "Pelican" | 8 in. | — | S |
| "Spoonbill" | 8 in. | — | S |
| "Cannet" | 8 in. | — | S |

**Queensland Cement & Lime Co. Ltd., P.O. Box 3, Darra, Queensland 4076**

| | | | |
|---|---|---|---|
| "Coral" | 36 in. | 3,000 hp | CS/M |
| "Kawana" | 16 in. | 725 hp | CS/M |

**Ravenshoe Tin Dredging Ltd., P.O. Box 9, Mt. Garnet, Queensland 4872**

| | | | |
|---|---|---|---|
| "Tableland Dredge" | 16 cu. ft. | — | BL/M |
| "Ravenshoe Dredge" | 12 cu. ft. | — | BL/M |

**South Australia Dept. of Marine & Harbors, P.O. Box 19, Pt. Adelaide, So. Australia 5032**

| | | | |
|---|---|---|---|
| "South Australian" | 48 in. | 1,100 hp | CS |
| "Andrew Wilson" | — | 800 hp | BG |
| "No. 8 Dredge" | 500 L | 760 hp | BL |

Vacant—director general;
J.M. Jenkin—deputy director general;
Capt. R.D. Pearson—director, ports and marine operations;
P.R. Salisbury—director, engineering;
K.R. Freeman—director, administration & finance.

The management and development of the State's commercial and other ports including the Port of Adelaide and the deep sea ports at Port Pirie, Port Lincoln, Thevenard, Wallaroo and Port Giles.

**State of New South Wales Department of Public Works, State Office Block, Phillip Street, Sydney, New South Wales, 2000**

| | | | |
|---|---|---|---|
| "John Main" | — | 1,200 hp | B |

**Townsville Harbor Board, P.O. Box 1031, No. 1 The Strand, Townsville, North Queensland 4810, Tel.: 72-1011, Cable: NAUSPORT, Telex: NAPORT 47334**

| | | | |
|---|---|---|---|
| "A.C.C.I" | 50 cu. m. | 1,200 hp | CS |
| "Grabdredge" | 2 cu. m. | 140 hp | BG |

A.G. Field—chairman;
I.G. Malpas—secretary/chief executive officer;
W.S. Service—engineer.

**Westham Dredging Company Pty. Ltd., Goldfield House, 1 Alfred St., Sydney, N.S.W. 2000**

| | | | |
|---|---|---|---|
| "W.H. Resolution" | — | 11,100 hp | TH |
| "W.H. Kunara" | — | 10,000 hp | CS |
| "W.H. Karlye" | — | 4,600 hp | CS |
| "W.H. Goomai" | — | 1,400 hp | BG BC |
| "W.H. Sirius" | — | 2,850 hp | * |
| "W.H. Supply" | — | 2,850 hp | * |

* "Sirius" and "Supply" are high speed self elevating platforms currently equipped for bulk drilling and blasting operations.

H.J. Leistikow—managing director;
E.M. Willcock—executive director, contracts manager.

*(See Royal Boskalis Westminster N.V., The Netherlands).*

## THE BAHAMAS

**Ministry of Maritime Affairs, P.O. Box 1417, Nassau**

| | | | |
|---|---|---|---|
| "David S. Morrison" | — | 730 hp | BG |

## BAHRAIN

**Bahrain Dredging Co. W.L.L., P.O. Box 5007, Mahama State of Bahrain, Tel.: 245396; Telex: 8409 dredge bn**
*(See Zanen Verstoep N.V., The Netherlands).*

## BANGLADESH

**Bangladesh Wapda, R.K. Das Road, Netaigani, Narayanganj, Dacca, Bangladesh**

| | | | |
|---|---|---|---|
| "Aminul Bahr" | — | 1,700 hp | CS |
| "Safinatul Hassan" | — | — | CS |

**Chittagong Port Authority, Bandar Bhaban, P.O. Bandar, Chittagong**

| | | | |
|---|---|---|---|
| "M.D. Al-Amanaj" | 1,750 tons | 2,300 hp | SH |
| "S.D. Karnafuli" | 600 tons | 900 hp | GH |

## BELGIUM

**Algemene Onderemingen, Verheye, Diksmuide**

| | | | |
|---|---|---|---|
| "Makasi" | 16 in. | | CS |

**Andredco, Noorderlaan 147, Bus 6A, 2030 Antwerp**
*(See Hollandsche Aanneming Maatschappij bv, The Netherlands).*

**Boskalis Westminster Aannemers N.V., 27, Korte Gasthuisstraat, 2000 Antwerp**
*(See Royal Boskalis Westminster Group N.V., The Netherlands).*

**CEI, Bagger-en Grondwerken Noorderlaan 147 Bus 6A 2030 Antwerp**
*(See HAM, The Netherlands).*

**Decloedt et Fils, S.A. (Overseas), Av. Franklin Roosevelt, 11, B-1050 Brussels**

| | | | |
|---|---|---|---|
| "Vlaanderen XVIII" | 14,800 cu. yds. | 14,163 hp | TH |
| "Pacifique" | 12,110 cu. yds. | 12,800 hp | TH |
| "Vlaanderen XX" | 6,540 cu. yds. | 10,380 kW | TH |
| "Vlaanderen XII" | 2,980 cu. yds. | 3,730 hp | TH |
| "Vlaanderen I" | 2,600 cu. yds. | 1,800 hp | TH |
| "Vlaanderen XXI" | 2,290 cu. yds. | 3,222 kW | TH |
| "Vlaanderen XVII" | 1,050 cu. yds. | 1,260 hp | TH |
| "Vlaanderen IV" | 850 cu. yds. | 900 hp | TH |
| "Vlaanderen XIX" | 35.5 in. | 16,100 hp | CS |
| "Vlaanderen XI" | 28 in. | 3,850 hp | CS |
| "Wombat" | 27.5 in. | 5,700 hp | CS |
| "D.C. 202" | 22 in. | 2,520 hp | CS |
| "Vlaanderen X" | 12 in. | 470 hp | CS |
| "Vlaanderen XV" | 12 in. | 470 hp | CS |
| "Volkracht II" | 31 cu. ft. | 450 hp | BL |
| "Volkracht IV" | 21 cu. ft. | 650 hp | BL |

**Dredging International N.V., Scheldedijk 30, B-2730 Zwijndrecht, Tel.: 3/252.65.26, Telex: 31839 Dredge B**

**Full ownership:**

| | | | |
|---|---|---|---|
| "Antwerpen IV" | 6,393 cu. yds. | 9,738 hp | TH |
| "Schelde II" | 4,185 cu. yds. | 8,460 hp | TH |
| "Maas" | 3,924 cu. yds. | 8,735 hp | TH |
| "Krankeloon" | 3,531 cu. yds. | 8,018 hp | TH |
| "LESSE I" | 2,614 cu. yds. | 3,900 hp | TH |
| "Dender" | 1,046 cu. yds. | 2,020 hp | TH |
| "Rupel" | 9,417 cu. yds. | 16,920 hp | TH |
| "Schelde" | 1,308 cu. yds. | 1,530 hp | SH |
| "Leie" | 37, 40 in. | 8,966 hp | CS |
| "Rubens" | 33, 46 in. | 15,549 hp | CS |
| "Reina Fabiola" | 29, 53 in. | 8,663 hp | CS |
| "Demer" | 29, 53 in. | 6,327 hp | CS |
| "Brabo" | 25, 59 in. | 6,865 hp | CS |
| "Kieldrecht" | 23, 62 in. | 2,138 hp | CS |
| "Durme" | 20 in. | 3,368 hp | CS |
| "Renaissance" | 29, 53 in. | 3,158 hp | CS |
| "Kallo" | 25, 59 in. | 5,877 hp | CS |
| "Lillo" | 14 in. | 978 hp | CS |
| "Warche" | 25, 59 in. | 2,695 hp | S |
| "Warche II" | 25, 59 in. | 3,076 hp | S |
| "Mark" | 29, 53 in. | 1,514 hp | S |
| "Gete" | 23, 62 in. | 1,502 hp | S |
| "Namur" | 31.08 cu. ft. sand | 1,233 hp | BL |
| | 18.43 cu. ft. rock | — | — |
| "Ijzer" | 28.25 cu. ft. | 504 hp | BL |
| "Big Boss" | 229.56 cu. ft. | — | — |
| | 282.50 cu. ft. | 2,778 hp | BB |
| | 406.07 cu. ft. | — | — |
| "Samson" | 194.26 in. | 1,346 hp | BB |
| | 116.49 in. | — | — |
| "Atlantique" | 6,278 cu. yds. | 8,796 hp | TH |
| "Mascaret" | 29, 53 in. | 9,098 hp | CS |
| "Mistral" | 29, 53 in. | 6,725 hp | CS |
| "Lamproie" | 21, 65 in. | 2,200 hp | CS |
| "Netzahualcoyotl" | 79, 68 in. | 1,873 hp | CS |
| "Asia" | 31, 78 cu. ft. sand | 955 hp | BL |
| | 18, 43 cu. ft. rock | — | — |

Dredging International N.V. (°1974) is a merger of the Belgian dredging companies Ackermans & van Haaren and S.G.D.

Types of work: dredging and reclamation, access channels, beach nourishment and protection, rockbreaking, gravel dredging and supply, and wreck removal.

Company officials are:
Ph. Fiers—director;
E. Clymans—head of technical department;
C. Claeys—head of research and development department;
G. Timmermans—head of personnel department.

**Hatraba, N.V., 51, Kapellenhoflaan, 2160 St. Antonius-Zoersel**
*(See Joh. Boele B.V., The Netherlands).*

**Jan de Nul N.V., P.O. Box 40, 9300 Aalst**

| | | | |
|---|---|---|---|
| "Sanderus" | 6,540 cu. yds. | 8,614 hp | TH |
| "James Ensor" | 4,680 cu. yds. | 9,987 hp | TH |
| "Galilei" | 2,600 cu. yds. | 3,370 hp | TH |
| "Marco Polo" | 35 in. | 20,088 hp | CS |
| "Vesalius" | 34 in. | 12,600 hp | CS |
| "Ortelius" | 32 in. | 6,925 hp | CS |
| "Mecator" | 32 in. | 6,515 hp | CS |
| "Dirk Martens" | 30 in. | 3,218 hp | CS |
| "Hondius" | 26 in. | 3,492 hp | CS |
| "Dirk I" | 20 in. | 2,608 hp | CS |
| "Petrus Plancius" | 20 in. | 1,516 hp | CS |
| "Jan Pieter I" | 18 in. | 2,578 hp | CS |
| "Jan Pieter II" | 18 in. | 1,583 hp | S |

More than 45 years passed since ir. Jan F.J. de Nul founder of the group of Companies Jan De Nul started his activities on the Belgian construction market.

A few years after World War II, Jan de Nul extended its activities from civil engineering, dry earthworks and construction works to dredging works.

The ongoing policy of expansion and growth through ever reinvesting of cash flow has made Jan de Nul N.V. now one of the biggest companies in Belgium in the execution of big public works and is one of the leading companies on the international market for the execution of dredging and/or reclamation works.

The work they perform ranges over many types and includes construction of water treatment stations, sewerage, railways, bridges, locks, quaywalls, canals, earthworks, metro's, tunnels, water reservoirs and especially dredging and reclamation works worldwide.

Company officials include:
Ir. J.P.J. De Nul—managing director;
C.ing. G. Vandewalle—overseas contracts manager;
Dr.j.K. Bogaert—commercial manager;
Ir. Ph. De Nys—asst. manager international division;
Ir. R. Vauterin—manager international division.

**N.V.J. Prins van Wijngaarden, Oscar van Kesbeeckstraat 4, 2800 Mechelen**
*(See P.V.W. International Dredging & Harbor Works, Hasselt, The Netherlands).*

## BOLIVIA

**Compania Minera del Sur, S.A. (Comsur), Casilla 4326, La Paz**

| | | | |
|---|---|---|---|
| "Alexandra" | 6 cu. ft. | 950 hp | BL/M |
| "Martha Wash Plant" | 6 cu. yds. | 865 hp | BDR |
| "SAPI" | 11 cu. ft. | 1,010 hp | BL/M |
| "La Palca Wash Plant" | 1½ cu. yds. | 395 hp | BB/M |

**Estalsa, P.O. Box 474, La Paz**

| | | | |
|---|---|---|---|
| "Avicava" | 14 cu. ft. | 1,250 hp | BL/M |

## BRAZIL

**Companhia Brasileira de Dragagem, Rua Dom Gerardo,35-9° andares, CEP 20090, Rio de Janeiro, Tel.: (021) 223-3200 PABX, Telex: (021) 31.306**

| | | | |
|---|---|---|---|
| "Boa Vista" | 5,000 cu. yds. | 10,000 hp | TH |
| "Macapa" | 5,000 cu. yds. | 10,000 hp | TH |
| "Guanabara" | 4,000 cu. yds. | 6,700 hp | TH |
| "Minas Gerais" | 700 cu. yds. | 2,454 hp | TH |
| "Rio de Janeiro" | 700 cu. yds. | 2,454 hp | TH |
| "Sao Paulo" | 24 in. | 4,800 hp | CS |
| "Sergipe" | 24 in. | 4,800 hp | CS |
| "Parana" | 24 in. | 4,800 hp | CS |
| "Pernambuco" | 24 in. | 4,800 hp | CS |
| "Espirito Santo" | 24 in. | 3,100 hp | CS |
| "Mato Grosso" | 20 in. | 2,760 hp | CS |
| "Goias" | 18 in. | 1,420 hp | CS |
| "Ceara" | 18 in. | 2,040 hp | CS |
| "Brasilia" | 850 L | 1,385 hp | BL |
| "Europa" | 700 L | 500 hp | BL |

Companhia Brasileira de Dragagem is a society of public and private stockholders linked to the Ministry of Transport since April 1, 1967. Its main activities are dredging, reclamation, soundings, breakwaters, underwater drilling, blasting, rock removal, laying and trenching of underwater pipelines, detection and removal of sunken hulls and objects; surveys, plans and projects for the performance of the above services, as well as all other activities relating to dredging and reclamation.

**Companhia Docas de Santos, Avenida Rio Branco 46, Rio de Janeiro**

| | | | |
|---|---|---|---|
| "Vera Cruz" | — | — | BG |

**Companhia Minas de Passagem, Passagem de Mariana, Mariana MG**

| | | | |
|---|---|---|---|
| "Santa Barbara" | 12 in. | — | S/M |
| "Sante Fe" | 10 in. | — | S/M |
| "Santa Maria" | 8 in. | — | S/M |

**Ecisa-Engenharia Comercio & Industria S.A., Rua Senador Dantas, 74-12° Andar, Rio de Janeiro, R.J.**

| | | | |
|---|---|---|---|
| "Ecisa 4" | 16 in. | — | S |
| "Ecisa 3" | 12 in. | — | S |

**Empresa Brasileira Engenharia e Comercio S.A.(EBEC), Avenida Graca Aranha, 206-4°, Grupos 1, 2 e 4, Rio de Janeiro, 20030, Tel.: 240-0995, Telex: (021) 32847**

| | | | |
|---|---|---|---|
| "EBEC 5" | 20 in. | 1,550 hp | CS |
| "EBEC 6" | 20 in | 1,550 hp | CS |
| "EBEC 8" | 20 in. | 1,550 hp | CS |
| "EBEC 3" | 18 in. | 1,300 hp | CS |
| "Thelma" | 14 in. | 700 hp | CS |
| "EBEC 9" | 14 in. | 750 hp | CS |
| "EBEC 2" | 12 in. | 600 hp | CS |
| "Paranagua" | 12 in. | 600 hp | CS |
| "EBEC 10" | 14 in. | 700 hp | CS |
| "EBEC 11" | 20 in. | 1,550 hp | CS |

**Enterpa S/A Engenharia, Avenida Presidente Giovanni Gronchi, 7007, Sao Paulo/SP—05724, Tel., (011) 548.7700, Telex: (011) 24751 TERP BR**

| | | | |
|---|---|---|---|
| "Enterpa I" | 12 in. | 860 hp | CS |
| "Enterpa II" | 12 in. | 860 hp | CS |
| "Enterpa III" | 14 in. | 700 hp | CS |
| "Enterpa IV" | 20 in. | 1,550 hp | CS |
| "Enterpa V" | 14 in. | 700 hp | CS |
| "Enterpa VI" | 20 in. | 1,550 hp | CS |
| "Enterpa VII" | 14 in. | 700 hp | CS |
| "Santa Ines" | 14 in. | 700 hp | CS |
| "Santa Maria" | 8 in. | 400 hp | CS |
| "Santa Branca" | 8 in. | 400 hp | CS |

**Mineracao Brasiliense S.A., P.O. Box 50 78,900 Porto Velho-Ro**

| | | | |
|---|---|---|---|
| "Mibrasa" | 4¼ cu. ft. | 400 hp | BL/M |

**Mineracao Taboca S.A. Rua Haddock Lobo, 578 Sao Paulo**

| | | | |
|---|---|---|---|
| "No. 1" | 6 cu. ft. | 400 hp | BL/M |
| "No. 2" | 12 in. | | BWS/M |

**Mineracao Tejucana S.A., Avenida do Contorno 4924, CEP 30,000, Belo Horizonte, Minas Gerais**

| | | | |
|---|---|---|---|
| "Yuba 167" | 6 cu. ft. | 500 hp | BL/M |
| "Johnson No. 51" | 6 cu. ft. | 500 hp | BL/M |
| "Yuba 149" | 9 cu. ft. | 600 hp | BL/M |
| "Yuba 116" | 10.5 cu. ft. | 800 hp | BL/M |
| "Yuba 139" | 12 cu. ft. | 1,000 hp | BL/M |
| "Beaver 1000" | 16 in. | 1,000 hp | CS |
| "Beaver 700" | 14 in. | 700 hp | CS |
| "Alluvial Dredge" | 20 in. | 2,000 hp | CS |

This Company started operations in 1966, mining alluvial diamond and gold, at Jequitinhonha River in Minas Gerais State, Brazil. At that time, the Company started with a "Yuba 139", BL/M dredge.

Average yearly production is 70,000 karats of diamond and 200,000 gm. of gold.

Management personnel include:
Philippe Servaye—president;
Eduardo L. Fernandes—director superintendent;
Fernando Vieira—director of production.

**Sociedade Tecnica de Engenharia E Representacoes "STER" S.A. Ave. Presidente Wilson 210-Cobertura, Rio de Janeiro, RJ**

| | | | |
|---|---|---|---|
| "King" | 20 in. | 2,200 hp | CS |
| "Ster II" | 18 in. | 1,865 hp | CS |
| "Helena" | 16 in. | 1,215 hp | CS |
| "Santa Barbara" | 12 in. | 980 hp | CS |
| "Ster III" | 14 in. | 710 hp | CS |
| "Monica" | 12 in. | 608 hp | CS |

Founded in 1946, STER performs large and average projects in many sectors of Brazilian contracting. The company participates in 39% of all dredging and hydraulic filling in the country.

In addition to dredging, the company performs highway construction, airport construction, dams and water treatment stations in Brazil and other countries.

Management personnel include:
Leo Maniero Filho—director;
Osvaldo Longo—director;

## BURMA

**Board of Management for the Port of Rangoon, Strand Road, P.O. Box 85, Rangoon**

| | | | |
|---|---|---|---|
| "Kyant Khaing Yay" | — | 900 hp | BG |
| "Thaung Naing Yay" | 750 cu. m. | — | TH |

**Government of the Socialist Republic of Burma, Mercantile Marine Department, New Law Court Buildings, Strand Road, Rangoon**

| | | | |
|---|---|---|---|
| "Heinze" | — | — | BG |

## CAMEROUN

**Boskalis Westminster Cameroun S.A.R.L, Boite Postale 1114, Doula**

*(See Royal Boskalis Westminster N.V., The Netherlands).*

## CANADA

**Alcan Smelters and Chemicals Ltd., Exploitation Energie Electrique, C.P. 800 Arvida, Quebec**

| | | | |
|---|---|---|---|
| "Amco" | — | — | CS |

**Aluminum Co. of Canada, Ltd., Arvida, Quebec**

| | | | |
|---|---|---|---|
| "Saint Mathias" | 12 in. | — | CS |

**Aluminum Company of Canada, Ltd. Power Department—Isle-Maligne Powerhouse P.O. Box 800 Arvida, Quebec**

| | | | |
|---|---|---|---|
| "No. 1" | 10 in. | — | CS |

**Beaver Dredging Company Ltd., 2nd Floor, Yorke Centre, 145 King Street West, Toronto, Ontario M5H 1J8**

*(See Royal Boskalis Westminster Group N.V., The Netherlands).*

**Bever Dredging Co. Ltd., Suite 2812, 425-1st St., SW Calgary, Alta. T2P-3L8**

**Beaver Marine Construction, Div. Beaver Constr. Grp. Ltd., P.O. Box 1447 H.N.P.S., Halifax, Nova Scotia, B3K 5H7**

| | | | |
|---|---|---|---|
| "Beaver Belle" | 6 cu. yds. | — | BB |
| "Beaver Trojan" | 4 cu. yds. | — | BC |
| "Beaver Hercules" | 3 cu. yds. | — | BC |
| "Beaver Spartan" | 3 cu. yds. | — | BC |

Operating on the coast of Eastern Canada since 1969, specializing in dredging and in the construction of wharves and bridges.

Company personnel are:
John S. Newman—president;
Russel C. Scrim—executive vice president;
John Whalen—general manager-marine division.

**Canadian Dredge & Dock Company, Ltd., 60 Harbour Street, Toronto, Ontario M5J 1B8**

| | | | |
|---|---|---|---|
| "Henley" | 12 in. | 700 hp | CS |
| "Andrew B" | 6 cu. yds. | 600 hp | BC BD |
| "Derrick No. 1" | 8 cu. yds. | 650 hp | BC |
| "Derrick No. 4" | 5 cu. yds. | 400 hp | BC |
| "Derrick No. 3" | 3½ cu. yds. | 250 hp | BC |
| "Derrick No. 7" | 3½ cu. yds | 250 hp | BC |
| "Derrick Rock Prince" | 2 cu. yds. | 150 hp | BC |

**Catalogna Bros. Ltd., 2330 Norman Lachine, Montreal, Quebec**

| | | | |
|---|---|---|---|
| "L.G.E. D-101" | 10 in. | | S |

**Centennial Dredging & Sand Ltd., 12500 No. 5 Road, Richmond, British Columbia, V7A 4G1**

| | | | |
|---|---|---|---|
| "Centennial 11" | 18 ft. | 3,000 hp | CS |

**Dean Construction Co., Ltd., Box 3216, Tecumseh, Ontario N8N 2M4**

| | | | |
|---|---|---|---|
| "No. 2" | 4 cu. yds. | — | BC |
| "No. 9" | 4 cu. yds. | — | BC |
| "No. 10" | 4 cu. yds. | — | BB BC |
| "No. 6" | 1½ cu. yds. | — | BC |
| "Junior Dean" | 3/4 cu. yd. | — | BC |
| "Marc Dean" | 18 in. | 960 hp | CS |

Dean Construction, Co. Ltd., was started in 1926 by Mr. Americo Dean Sr. It was incorporated in the Province of Ontario under its present name in 1947.

Types of work performed: dredging, docks, marine pipelines, intakes and outfalls, pile driving, cassions, heavy construction dams, bridges and excavation.

**Department of Public Works of Canada, Sir Charles Tupper Bldg., Ottawa, Ontario K1A 0M2**

| | | | |
|---|---|---|---|
| "D.P.W. No. 312" | 1,330 cu. yds. | 4,124 hp | TH |
| "D.P.W. No. 322" | 20 in. | 2,050 hp | CS |
| "D.P.W. No. 224" | 12 in. | 715 hp | CS |
| "D.P.W. No. 12" | 12 in. | 592 hp | CS |
| "D.P.W. No. 250" | 12 in. | 444 hp | CS |
| "D.P.W. No. 33" | 10 in. | 533 hp | S |
| "D.P.W. No. 32" | 10 in. | 340 hp | CS |
| "D.P.W. No. 201" | 10 in. | 645 hp | CS |
| "D.P.W. No. 253" | 10 in. | 165 hp | CS |
| "D.P.W. No. 30" | 8 in. | 261 hp | CS |
| "D.P.W. No. 31" | 8 in. | 480 hp | CS |
| "D.P.W. No. 125" | 8 in. | 168 hp | CS |
| "D.P.W. No. 401" | 2 cu. yds. | 194 hp | BG |
| "D.P.W. No. 130" | 4½ cu. yds. | 1,000 hp | BD BC |
| "D.P.W. No. 205" | 2 cu. yds. | 336 hp | BD |
| "D.P.W. No. 210" | 1½ cu. yds. | 261 hp | BD |
| "D.P.W. No. 400" | 1¼ cu. yds. | 1,189 hp | GH |
| "D.P.W. No. 129" | 1¼ cu. yds. | 210 hp | BG |
| "D.P.W. No. 128" | 1¼ cu. yds. | 149 hp | BG |
| "D.P.W. No. 10" | 1½ cu. yds. | 270 hp | BB BG |
| "D.P.W. No. 24" | 1½ cu. yds. | 270 hp | BB BG |
| "D.P.W. No. 23" | 1½ cu. yds. | 270 hp | BB BG |
| "D.P.W. No. 16" | 3/4 cu. yds. | 313 hp | BG |

**Dillingham Construction Ltd., 20 Brooksbank Avenue, North Vancouver, British Columbia, V7J 2B8**

| | | | |
|---|---|---|---|
| "Kind Edward" | 24 in. | 5,500 hp | CS |
| "Dillingham No. 2" | 6 cu. yds. | — | BC |
| "Dillingham No. 3" | 5 cu. yds. | — | BC |
| "Dillingham No. 4" | 6 cu. yds. | — | BC |
| "Dillingham No. 5" | 4 cu. yds. | — | BC |
| "Dillingham No. 1" | 2 cu. yds. | — | BC |
| "Dillingham No. 6" | 6 cu. yds. | — | BC |

Dillingham Construction Ltd. and its predecessor companies have been involved in dredging and marine construction since 1913 on the West Coast of Canada. The company also undertakes international contracts.

J.R. Baker—pres. and chief executive officer;
K.A. Hale—vice pres., finance & administration;
R.J. Minarcini—vice. pres., marine & hvy. constr.;
H.N. Tucker—manager, marine division.

**Harbour Development (A Division of Atlantic Towing Ltd.), P.O. Box 497, Dartmouth, Nova Scotia, B2Y 3Y8**

| | | | |
|---|---|---|---|
| "Swellmaster" | 1,200 cu. yds. | 2,500 hp | TH |
| "Depthmaster" | 14 in. | 800 hp | CS |
| "Cranemaster" | 8 cu. yds. | 1,500 hp | BC |
| "Shovelmaster" | 8 cu. yds. | 1,500 hp | BD |

**The J.P. Porter Co. Ltd., Room 806, Dominion Square Building, 1405 Peel Street, Montreal, Quebec**

| | | | |
|---|---|---|---|
| "J.P.P. No. 600" | — | 1,050 hp | SH |
| "J.P.P. No. 601" | — | 1,050 hp | SH |

**Kootenay Dredging & Pile Driving Ltd., No. 1 Front St., New Westminster, British Columbia**

| | | | |
|---|---|---|---|
| "Ledingham" | 8 in. | — | CS |

**Louiseville Generale Enterprise Engr., Box 158, Louiseville, Quebec J5V 2L6**

| | | | |
|---|---|---|---|
| "L.G.E. D-102" | 16 in. | — | S |
| "M.C.G. No. 1" | 2 cu. yds. | — | BC |

**Maritime Dredging Limited, P.O. Box 442, Charlottstown, P.E.I., C1A 7K7**

| | | | |
|---|---|---|---|
| "Rebecca W." | 10 in. | 300 hp | CS |
| "Inlander" | 10 in. | 357 hp | CS |

**McNamara Marine, P.O. Box 418, Whitby, Ontario L1N 5S4**

| | | | |
|---|---|---|---|
| "Charles R. Huntley" | 20 in. | — | TH |
| "Canadian" | 36 in. | — | CS |
| "William Oxby" | 30 in. | — | CS |
| "Ospwagan" | 30 in. | — | CS |
| "John Holden" | 16 in. | — | CS |
| "Charles M." | 12 in. | — | CS |
| "McNCO No. 79" | 4 cu. yds. | — | BD BC |
| "Harold M." | 4 cu. yds. | — | BD BC |
| "Gunnar 154" | 4 cu. yds. | — | BC |
| "McNCO No. 20" | 4 cu. yds. | — | BD BC |

**Northern Construction Company, Ltd., 1304 Hornby Street, Vancouver, British Columbia, V6Z 1W6**

| | | | |
|---|---|---|---|
| "Arctic Northern" | 24 in. | 3,200 hp | CS |
| "MacKenzie Northern" | 16 in. | — | CS BWS |
| "G.C. 26" | 6 cu. yds. | — | BC |
| "G.C. 27" | 6 cu. yds. | — | BC |
| "N.W.D. No. 209" | 6 cu. yds. | — | BC |
| "N.W.D. No. 214" | 6 cu. yds. | — | BC |
| "N.W.D. No. 216" | 6 cu. yds. | — | BC |
| "N.W.D. No. 203" | 5 cu. yds. | — | BC |
| "N.W.D. No. 211" | 3 cu. yds. | — | BC |

Northern Construction Company, Ltd., which was incorporated in 1904, specializes in docks, bridges and offshore marine structures, completing 18 artificial islands in the Canadian Arctic.

Company officials are:
J.R. Hall—president;

D.E. Coulter—vice president;
L.N. Spencer—vice president;
J.F. Lacey—secretary and controller.

**Northern Transportation Co., 9945, 108th Street, Edmonton, Alberta, T5K 2Q6**

| | | | |
|---|---|---|---|
| "N.T. 1506" | — | — | S |

**Ontario-Lake Erie Sand Ltd., 2027 Rebecca Street, Oakville, Ontario**

| | | | |
|---|---|---|---|
| "W.M. Edington" | — | 735 hp | SH |

**Pitts Engineering Construction, a Div. of Banister Continental Ltd., 7500 Woodbine Ave., Markham, Ontorio L3R 4M8**

| | | | |
|---|---|---|---|
| "Canadian Argosy" | 9 cu. yds. | — | BG/BD |
| "Pitts-Olympic" | 8 cu. yds. | — | BC |
| "Pitts-Centennial" | 5 cu. yds. | — | BG |
| "Canadian Jubilee" | 8 cu. yds. | — | BG |
| "Pitts No. 7" | 4 cu. yds. | (jackup) | BC |
| "Pitts Carillon" | 4 cu. yds. | — | BG |

Pitts Engineering is a publicly-owned Canadian civil engineering contractor. The company is engaged in dredging, dock and harbor developments, underwater pipelines, large-scale energy developments, multi-ane highways, subways, bridges, dams and tunnels.

The company's operations extend across Canada, from British Columbia in the west to the Maritime provinces in the east, and include the far north and arctic regions.

**Sceptre Dredging Ltd., 14400 River Road, Richmond, B.C. V6V 1L3**

| | | | |
|---|---|---|---|
| "Sceptre Squamish" | 42 in. | 15,400 hp | CS |
| "Sceptre Columbia" | 26 in. | 5,000 hp | CS |
| "Sceptre Fraser" | 36 in. | 6,800 hp | CS |
| "General Montcalm" | 24 in. | 4,000 hp | CS |
| "General Brock" | 24 in. | 5,500 hp | CS |
| "General Levis" | 20 in. | 3,000 hp | CS |
| "Shaunlah" | 20 in. | 3,000 hp | CS |
| "M.P. 114" | 16 in. | 3,400 hp | CS |
| "M.P. 112" | 16 in. | 1,000 hp | CS |
| "Ile aux Coudres" | 3,500 cu. yds. | — | TH |
| "Lockeport" | 1,000 cu. yds. | — | TH |
| "Sceptre Skeena" | 7 cu. yds. | — | BC |
| "Hamilton 56" | 6 cu. yds. | — | BC |
| "Nova Scotia" | 4 cu. yds. | — | BB |
| "Louis D." | 7 8 cu. yd. | — | B |

**Standard Dredging Co., Ltd., Box 1410, Saint John, New Brunswick E2L 4J9**

| | | | |
|---|---|---|---|
| "Leconfield II" | 8,000 cu. yds./day | — | BL |
| "O.T. No. 9" | 200 cu. yds./hr. | — | BC |

**Thompson Marine Ltd., P.O. Box 87, Pointe au Baril, Ontario POG 1KO, Tel.: (705) 366-2235**

| | | | |
|---|---|---|---|
| "Alexander" | 1 cu. yd. | — | BG |

**Vancouver Divers & Contractors Ltd., 122 West 42nd Avenue, Vancouver, B.C., V5Y 2T1**

| | | | |
|---|---|---|---|
| "Seaport" | 8 in. | 200 hp | CS |
| "#1 DR." | 1 4 yd. | 100 hp | BB |
| "#2 DR." | 8 in. | 180 hp | S |
| "#3 DR." | 4 in. | 20 kW | S |
| "#4 DR." | 1 3 yd. | 120 hp | BB |
| "#5 DR." | 1 yd. | 150 hp | BC |

Vancouver Divers & Contractors Ltd. have been serving the marine industry since 1958. General marine contractors, diving and dredging specialists.

R.J. Bamford—president.

## CHILE

**Compania Naviera Arauco S.A., Castilla 145v, Valparaiso,**

| | | | |
|---|---|---|---|
| "Loreto" | — | — | GH |

**Government of The Republic of Chile, (Ministero de Obras Publicas), Valdivia 3933.**

| | | | |
|---|---|---|---|
| Ernesto Pinto L" | — | — | SH |

## CHINA PEOPLE'S REPUBLIC OF

**China National Machinery Import & Export Corp., Peking**

| | | | |
|---|---|---|---|
| "CO 823" | 4,500 cu. m. | 9,150 hp | TH |
| "CO 824" | 4,500 cu. m. | 9,150 hp | TH |
| "CO 825" | 4,500 cu. m. | 9,150 hp | TH |
| "CO 826" | 4,500 cu. m. | 9,150 hp | TH |
| "CO 834" | 1,500 cu. m. | 4,890 hp | TH |
| "CO 835" | 1,500 cu. m. | 4,890 hp | TH |
| "CO 836" | 1,500 cu. m. | 4,890 hp | TH |
| "CO 837" | 1,500 cu. m. | 4,890 hp | TH |
| "CO 838" | 1,500 cu. m. | 4,890 hp | TH |
| "CO 839" | 1,500 cu. m. | 4,890 hp | TH |
| "CO 840" | 1,500 cu. m. | 4,890 hp | TH |
| "CO 841" | 1,500 cu. m. | 4,890 hp | TH |
| "CO 842" | 1,500 cu. m. | 4,890 hp | TH |
| "CO 843" | 1,500 cu. m. | 4,890 hp | TH |

Bucket Ladder Mining Dredges:
Reports indicate at least 27-BL/M, 8 cu. ft. bucket capacity dredges mining gold.

## COLOMBIA

**Assn. Nac. de Navieros, "Adenadi," Edifico Montes Calle 33 No. 45-56 Barranquilla**

| | | | |
|---|---|---|---|
| "Rio Magdalena" | 20 in. | — | CS |

**Ministerio de Obras Publicas y Transporte, Bogota**

| | | | |
|---|---|---|---|
| "DH-6" | 400 cu. m./hr. | — | CS |
| "DH-3" | 300 cu. m./hr. | — | CS |
| "DH-7" | 250 cu. m./hr. | — | CS |
| "DH-8" | 250 cu. m./hr | — | CS |
| "DH-1" | 200 cu. m./hr. | — | CS |
| "DH-2" | 200 cu. m./hr | — | CS |
| "DH-5" | 200 cu. m./hr. | — | CS |
| "DH-9" | 200 cu. m./hr. | — | CS |
| "DH-10" | 200 cu. m./hr. | — | CS |
| "DHC-1" | 200 cu. m./hr. | — | CS |
| "DHC-2" | 300 cu. m./hr. | — | CS |
| "DHC-3" | 300 cu. m./hr. | — | CS |
| "DHC-4" | 1,400 cu. m./hr. | — | CS |
| "DHC-5" | 325 cu. m./hr. | — | CS |
| "DHC-6" | 300 cu. m./hr. | — | CS |
| "DHC-7" | 300 cu. m./hr. | — | CS |
| "DHC-8" | 600 cu. m./hr. | — | CS |
| "DHC-9" | 300 cu. m./hr. | — | CS |
| "DHC-10" | 200 cu. m./hr. | — | CS |
| "DHC-7" | 275 cu. m./hr. | — | CS |
| "DH-11" | 500 cu. m./hr. | — | CS |

**Government of The Republic of Colombia, Carrera 13 27-00, Bogota**

| | | | |
|---|---|---|---|
| "Ciudad De Barranquilla" | 2,640 hp | — | SH |

**Mineros de Antioquia, S.A., Apartado Aeroeo, 1306 Medellin**

| | | | |
|---|---|---|---|
| "Antioquia" | 13¾ cu. ft. | 1,200 hp | BL M |
| "Boyaca" | 13¾ cu. ft. | 1,450 hp | BL M |
| "Colombia" | 13¾ cu. ft. | 1,000 hp | BL M |
| "Jobo" | 13¾ cu. ft. | 1,450 hp | BL M |
| "San Francisco" | 13¾ cu. ft. | 1,450 hp | BL M |
| "Dobaibe" | 18 cu. ft. | 2,200 hp | BL M |

## CUBA

**Government of The Republic of Cuba, (Empresa de Servicios Especializados Obras Maritime), Galixto, Garcia 1, Regla, Havana**

| | | | |
|---|---|---|---|
| "Revolucion" | — | — | CS |

## CZECHOSLOVAKIA

**Administration Authority of the Waterway Danube, Bratislava**

| | | | |
|---|---|---|---|
| "Vtacnik" | 20 in. | — | CS |
| "Krivan" | 350 liters | — | BC |
| "Podbansko" | 300 liters | — | BC |
| "Paula" | 120 liters | — | BC |

**Administration Authority of the Waterway Vitava, Praha**

| | | | |
|---|---|---|---|
| "SB 20" | 6 in. | — | S |
| "SB 20" | 6 in. | — | S/BC |

**Moravian Gravel & Sand Exploitation Plants, Olomouc**

| | | | |
|---|---|---|---|
| "V 80" | 55 liters | — | BC/M |
| "V 100" | 250 liters | — | BC/M |
| "PKR" | 250 liters | — | BC/M |
| "V 50" | 40 liters | — | BC/M |

## DENMARK

**Ahlsell & Agven A/S, 3700 Ronne, Bornholm**

| | | | |
|---|---|---|---|
| "Ahlsell" | — | 300 hp | S |

**A/S Carl Nielsen, Islands Bygge 4, 2300 Copenhagen, S.**

| | | | |
|---|---|---|---|
| "Disken" | — | 420 hp | S |
| "Georg Nielsen" | — | 420 hp | S |
| "Kai Nielsen" | — | 2,400 hp | SH |
| "Kronborg" | — | 1,355 hp | SH |
| "Navo" | — | 800 hp | S |

**A/S Hotaco, Kaersangervej 82, 4300 Holbaek**

| | | | |
|---|---|---|---|
| "Ota" | — | 280 hp | SH |

**A/S Peter Madsen Rederi, Santadrievej Postboks 38, 8680 Ry**

| | | | |
|---|---|---|---|
| "John Madsen" | — | 300 hp | — |
| "Peter Madsen" | — | 230 hp | S |

**A/S Ulve Beton, 7100 Vejle**

| | | | |
|---|---|---|---|
| "Chabira" | — | 400 hp | SH |

**Danena A/S, P.O. Box 151, 8100 Aarhus C**

| | | | |
|---|---|---|---|
| "Baltic" | 1,100 cu. yds. | 1,000 hp | TH |
| "Botnia" | 710 cu. yds. | 1,000 hp | TH |
| "Nordia-N" | 710 cu. yds. | 1,000 hp | TH |
| "Skandia" | 690 cu. yds. | 1,000 hp | TH |
| "Rheia" | 500 cu. yds. | 800 hp | TH |
| "Kronos" | 480 cu. yds. | 600 hp | SH |
| "Gaia" | 480 cu. yds. | 500 hp | SH |
| "Atlas" | 470 cu. yds. | 500 hp | SH |
| "Asco" | 335 cu. yds. | 400 hp | SH |
| "Titan" | 325 cu. yds. | 400 hp | SH |
| "Knoben" | 210 cu. yds. | 300 hp | SH |

Aktieselskabet DANENA is a shipping and ship-owning company situated in Arhus, Denmark. Since 1950 it has specialized in dredging.

DANENA's main working fields are the Baltic, the North Sea and Danish waters.

It specializes in reclamation, harbor constructions and enlargements, industrial buildings, container areas, beach reclamation, channel and maintenance dredging, pipe trench refilling, beach nourishment and delivery of sand and gravel for constructions and industrial purposes.

Aktieselskabet DANENA has a yard located in Aalborg for new building and maintenance of the fleet and equipment.

Around 120 people are employed in the company.

**Erik H. Hansen P/R, Bogholmsvej 2, Frederiksberg, 4180 Soro**

| | | | |
|---|---|---|---|
| "Helen" | — | 240 hp | — |

**Eva Sorensen P/R, Nordkajen 3, 7100 Vejle**

| | | | |
|---|---|---|---|
| "Grethe Peter" | — | 360 hp | S |

**Finn Holmsted Thomsen, 5700 Svenborg**

| | | | |
|---|---|---|---|
| "Henriette Sand" | — | 365 hp | S |

**Fru Susanne Andersen P/R Fyrrebakken 18, 3600 Frederiksund**

| | | | |
|---|---|---|---|
| "Putte Pan" | — | 510 hp | S |

**Government of The Kingdom of Denmark, (Stratshavenadministrasjonen), Postboks 2, 6700 Esbjerg**

| | | | |
|---|---|---|---|
| "Taurus" | 1,200 cu. m. | 2,780 hp | TH |

**Hans F.K. Frederiksen, Fayevej 31, 4900 Nakskov**

| | | | |
|---|---|---|---|
| "Soral" | — | 160 hp | — |

**Entreprenor PVW Havne og Vandbygning A/S Lejrvej 8, 6330 PADBORG, Tel. 4-670007, Telex: 52518**
*(See PVW International Dredging and Harbor Works. The Netherlands).*

**Hollandsche Aanneming Maatschappij Danmark ApS, c/o Reumert & Partnere Bredgade 26 1260 Kobenhavnk**
*(See Hollandsche Aanneming Maatschappij bv. The Netherlands).*

**Jens Rohde Nielsen ApS, Skippersgaarden, Rytterager 100, 2791 Dragor**

| | | | |
|---|---|---|---|
| "Progress" | — | 164 hp | SH |

**Jorgen J.J. Gibe, Tasingevel 9, 6780, Skaerbaek**

| | | | |
|---|---|---|---|
| "Inge Jytte" | — | 250 hp | BG |

**Kristen Dueholm P/R, 7600 Struer**

| | | | |
|---|---|---|---|
| "Remmer" | — | 200 hp | SH |

**Mogens August Larsen, Horne, 9850 Hirtshals**

| | | | |
|---|---|---|---|
| "Kirsten Ral" | — | 350 hp | S |

**N. Hojlund Hansen, Solvaenget 38, 5700 Svenborg**

| | | | |
|---|---|---|---|
| "Rigger Stevens" | — | 350 hp | SH |

**Nordsogrus I/S, 7200 Grindsted**

| | | | |
|---|---|---|---|
| "Adm. Courbet" | — | 400 hp | S |

**Saabye & Lerche A/S, Esplanaden 40, 1263 Copenhagen**

| | | | |
|---|---|---|---|
| U/M "Odin" | 630 L | 660 hp | BL |
| U/M "Thor" | 550 L | 660 hp | BL |
| U/M "Freja" | 16 in. | 2 x 360 hp | CS |
| "FC 10" | 2,000 L | 300 hp | BB |

**Simonsen O.S., 3890 Vagur, Faroe Islands**

| | | | |
|---|---|---|---|
| "Skuvanes" | — | 330 hp | S |

**State Ports Authority, Hulvejen, Esbjerg, P.O. Box 2, DK 6700**

| | | | |
|---|---|---|---|
| "Taurus" | 1,200 cu. m. | 3,120 hp | TH |
| "Trael" | 375 cu. m. | 665 hp | TH |
| "Toke" | 375 cu. m. | 640 hp | TH |
| "Toenne" | 300 cu. m. | 665 hp | TH |
| "Toste" | 300 cu. m. | 299 hp | GH |

The State Ports Authority is a government authority operating state owned ports on the Danish North Sea coast. It also operates the state owned dredging vessels serving to perform maintenance dredging in harbor basins and navigation channels.

**Stenco A/S, 5000 Odense**

| | | | |
|---|---|---|---|
| "Ormen" | — | 420 hp | S |
| "Toto" | — | 300 hp | S |

**Storebaelt Sten & Grus A/S, 4220 Korsor**

| | | | |
|---|---|---|---|
| "Musholm" | — | 198 hp | S |

**Sonderborg Sand ug Grus A/S, Norrehavn, 6400 Sonderborg**

| | | | |
|---|---|---|---|
| "Kristel" | — | 900 hp | SH |

**Superfos Dammann-Luxol A/S, Frydenlundsvej 30, Postboks 39, 2950-Verbaek**

| | | | |
|---|---|---|---|
| "Bodil Dammann" | — | 600 hp | — |
| "Carl Damman" | — | 280 hp | SH |

**Tons Jean Brunes, Bagsvaerd Hovengade 116A, 5880 Bagsvaerd**

| | | | |
|---|---|---|---|
| "Sigridur" | — | 365 hp | SH |

## ECUADOR

**Vialidad Del Guayas, Casill4182, Guayaquil**

| | | | |
|---|---|---|---|
| "Ecuador" | 16 in. | — | CS |
| "Guayas" | 12 in. | — | CS |

**Direccion de Dragado de la Armada, Avenida Jose Vicente Trujillo No. 200 y Rosa Borja de Icaza Dpto. 2 Guayaquil**

| | | | |
|---|---|---|---|
| "Rio Mataje" | 26 in. | — | CS |
| "Rio Pastaza" | 16 in. | — | CS |
| "Rio Cenepa" | 16 in. | — | CS |
| "Rio Daule" | 12 in. | — | CS |

## EGYPT

**The Arab Contractors, Osman Ahmed Osman & Co., 34 Adly St., Cairo, Tel.: 755223, Cable: OSMASON. Telex: 92239 OSMUN UN CAIRO**

| | | | |
|---|---|---|---|
| "El Safa" | 24 in. | 3,250 hp | CS |

| | | | |
|---|---|---|---|
| "El Sad El Ali" | 14 in. | 1,150 hp | CS |
| "10 Ramdan" | 12 in. | 1,100 hp | CS |
| "El Salam" | 14 in. | 770 hp | CS |
| "Port Said 2" | 14 in. | 850 hp | BS |
| "Port Said 1" | 14 in. | 800 hp | BS |

The Arab Contractors was begun in 1942 by Osman Ahmed Osman with the help of his two brothers Ibrahim and Mohamed. As the company became able to handle larger projects, the company named Industrial & General Enterprises Engineering Co., S.A.A., Osman Ahmed Osman & Co. was formed. This name has since been changed to the present name.

As the company's scope widened to other Arab countries, the Saudi Contractors, Kuwait Engineering Co., the Libyan Co., and an Abu Dhabi subsidiary were formed. Branch offices were also opened in Lebanon, Jordan, Iraq and Sudan.

The company employs more than 40,000 people and executes annual work valued at more than $7 billion.

The company contracts for ports and marine works, airports and runways, dams, land reclamation, factories, water purification and sewage treatment plants, pipe networks, transmission lines, power stations, bridges and tunnels.

Company officials are:
Eng. Hussein Ahmed Osman—chairman;
Eng. Mohamed Salah E. Hassaballa—senior vice president;
Eng. Hani Mohamed Salem—board member for mech. & elec. affairs;
Eng. Abdel Muneim El Ghayesh—general manager;
Eng. Mohamed Abdel Fattah—earth moving & dredging manager.

**Societe Annonyme du Behera, 21, Talaat Harb Street, Alexandria, Egypt**

| | | | |
|---|---|---|---|
| "Canal El Suez" | — | — | CS |

**Suez Canal Authority, Ismailia 16.9.81, Tel.: 2201, Telex: 92153 SUCANA UN**

| | | | |
|---|---|---|---|
| "Al-Seddiek" | 34 in. | 19,070 hp | CS |
| "Al-Khattab" | 34 in. | 19,070 hp | CS |
| "Tarek Ibn Zeyad" | 34 in. | 16,770 hp | CS |
| "Salalh El-Din El Ayoby" | — | 15,150 hp | TH |
| "Khofo" | 30 in. | 8,920 hp | CS |
| "Mahmoud Yones" | 30 in. | 8,730 hp | CS |
| "Ramsis" | — | 6,820 hp | TH |
| "26 July" | 30 in | 6,600 hp | CS |
| "10th of Ramadan" | 30 in. | 5,100 hp | CS |
| "Zenobia" | 24 in. | 2,200 hp | CS |
| "El Fateh" | 24 in. | 2,200 hp | CS |
| "Khafraa" | — | 1,400 hp | BL |
| "Mina No. 1" | — | 1,200 hp | BL |
| "Mina No. 2" | — | 1,200 hp | BL |
| "Nefertiti" | 14 in. | 545 hp | CS |

**Timsah Shipbuilding Co., P.O.B. 101 Helio. El-Horria Cairo**

| | | | |
|---|---|---|---|
| "Obour" | 35 cu. m. | 500 hp | CS |

## FINLAND

**City of Turku, Satamalaitos, Turku**

| | | | |
|---|---|---|---|
| "No. 2" | 10 in. | — | S |
| "No. 1" | 200 liters | — | BL |

**Kaivinyhtyma Veljet Salminen, Aarhusinkatu 3 E 130, 21310 Turku 31**

| | | | |
|---|---|---|---|
| "Terasmies 22" | 1.0 cu. m. | — | BG |

**Keski-Suomen Raivaus Oy, Ristila, 41500 Hankasalmi As**

| | | | |
|---|---|---|---|
| "Kahla 500-1" | 0.7 cu. m. | — | BB |

**Maansiirto Heinonen Oy, Hakalahdentie 5, 70460 Kuopio 46**

| | | | |
|---|---|---|---|
| "Manta" | 10 in. | — | CS |
| "Elsa" | 1.5 cu. m. | — | BB |
| "Elli" | 1.0 cu. m. | — | BB |

**OMP-Yhtyma Oy, P.O. Box 312, Messipojantie 20, 90501 Oulu 50**

| | | | |
|---|---|---|---|
| "Cat-235" | 1.8 cu. m. | — | BB |

**Oy Suomenlahden ruoppaus-Finnbay Dredging Co., P.B. 19, 00500 Helsinki 50 Finland**

| | | | |
|---|---|---|---|
| "Veli" | 600 L | 500 hp | BL |
| "Koura II" | 5 cu. m. | 950 hp | BB |
| "Koura" | 2 cu. m. | 326 hp | BB/BG |

**Port of Helsinki Authority, P.O. Box 26, SF-00131, Helsinki 13**

| | | | |
|---|---|---|---|
| "Anneli" | 4-5 cu. yds. | 200 hp | BG |

**MV-Rakennusosakeyhtio Juslenius, Yliopistonkatu 6 B, 20110, Turku 11**

| | | | |
|---|---|---|---|
| "Kahla" | 1.5 cu. m. | — | BB |
| "Polak" | 1.0 cu. m. | — | BB |

**Sah-ko Oy, P.O. Box 13, 90121, Oulu 12**

| | | | |
|---|---|---|---|
| "Roope III" | 1.0 cu. m. | — | BB |

**Saimaan Ruoppaus Oy, O. Tuuliainen, Ruukintie 1, 53200 Lappeenranta 20**

| | | | |
|---|---|---|---|
| "Imuri" | 12 in. | — | CS |
| "De Groot" | 12 in. | — | CS |
| "O&K RH-25" | 3.0 cu. m. | 253 hp | BB |

**Saimaan Ruoppaus, 54710 Lemi, Puhelin 62530**

| | | | |
|---|---|---|---|
| "No. 1" | 12 in. | — | S |
| "No. 2" | 12 in. | — | S |
| "No. 3" | 1,500 liters | — | BG |
| "Tursas 3" | 10 in. | — | CS |
| "Tursas 4" | 10 in. | — | CS |

**Sukellustyo Opas Ky, Viistokatu 38, 05800 Hyvinkaa**

| | | | |
|---|---|---|---|
| "Kaivaja" | 1.5 cu. m. | 253 hp | BB |

**Vesi-Pekka Oy, Kuoppatie 8-10, SF-00730, Helsinki 73, Tel.: 358-0-364 044**

| | | | |
|---|---|---|---|
| "Pekka VI" | 18 in. | 1,500 hp | CS |
| "Pekka I" | 18 in. | 1,400 hp | CS |
| "Pekka II" | 10 in. | 240 hp | CS |
| "Pekka III" | 10 in. | 240 hp | CS |
| "Pekka IV" | 12 in. | 710 hp | CS |
| "Pekka V" | 12 in. | 400 hp | CS |
| "Imu 1" | 12 in. | 530 hp | CS |
| "Imu 2" | 10 in. | 320 hp | CS |
| "Imu 3" | 12 in. | 530 hp | CS |
| "Vilma" | 12 in. | 700 hp | CS |
| "Imu 5" | 12 in. | 450 hp | CS |
| "Manu-Pekka M-4000" | 4.6 cu. m. | 1,050 hp | BB |
| "Meri-Pekka M-4600" | 4.6 cu. m. | 700 hp | BB |
| "Kuokka-Pekka 2" | 3.0 cu. m. | 400 hp | BB |
| "Kuokka-Pekka 3" | 1.9 cu. m. | 320 hp | BB |
| "Kuokka-Pekka 4" | 2.4 cu. m. | 320 hp | BB |
| "Kanmari 1" | 3.0 cu. m. | 300 hp | BG |

Vesi-Pekka Oy specializes in underwater construction activities. In the past 25 years the company has done a large amount of harbor building, channel blasting and dredging, drydock and similar projects. Tunnel blasting, sewage treatment plants, bridge and road building as well as wharves and quays are included in the company's activities. Vesi-Pekka Oy also designs equipment for dredging and rock blasting.

Company personnel are:
Paavo Lepanen—engineer (M.Sc.), managing director;
Teuvo Ali-Tolppa—deputy managing director;
Rauli Rautanen M.A.—(Econ.) financial director;
Mikko Sipinen—engineer (M.Sc.), technical director;
Esko Harju—manager of mechanical department

**Vesto Oy, Henry Fordinkatu 5 F, 00150 Helsinki 15**

| | | | |
|---|---|---|---|
| "Sarus" | 600 L | — | BL |
| "Tursas 1" | 16 in. | — | CS |
| "Tursas 2" | 10 in. | — | CS |
| "Tursas 4" | 10 in. | — | CS |
| "Merikuokka" | 4.5 cu. m. | — | BB |

Vesto Oy, founded in 1942, is a leading construction company in Finland. Its field of operations covers earth work and road construction, harbor works and dredging, bridges, tunnelling, water supply and environmental protection, industrial construction and power plants.

The company is active in home and international projects.

Company officers are:

Touko Allonen—M.Sc. (C. Eng.), president;
Heikki Koivisto—M.Sc. (C. Eng.), production director;
Erkki ETeLamaki—M.Sc. (C. Eng.), export director;
Asko Forsberg—M.Sc. (C. Eng.), director;
Pekka Ristikartano—B.Sc. (C. Eng.), construction manager.

## FRANCE

**Atlantique Dragage S.A., 9/15 Avenue Paul Doumer, 92508 Rueil Malmaison, Ledex**

*(See Royal Boskalis Westminster Group N.V., The Netherlands).*

**Dragages Transports & Travaux Maritimes, Hanger 3, Quai Nord, 1700 La Rochelle-Pallice**

| | | | |
|---|---|---|---|
| "Franjack" | — | 800 hp | S |

**Dumez Travaux Publics, 345 av. Georges Clemenceau, 92000 Nanterre**

| | | | |
|---|---|---|---|
| "Ifikia" | 24 in. | 3,000 hp | CS |
| "Marco" | 12 in. | 600 hp | CS |
| "Mayas" | 1,200 cu. m. | 4,000 hp | TH |

**Enterprises Morillon Corvol Courbot S.A., P.O. Box 501, 3 rue le Corbusier, 94152 Rungis Cedex**

| | | | |
|---|---|---|---|
| "Port de Sfax" | 26-28 in | 3,140 hp | CS |
| "Port Saint Louis" | 22-24 in. | 2,300 hp | CS |
| "Saint Malo" | 18 in. | 1,420 hp | CS |
| "La Rochelle" | 14 in. | 960 hp | CS |
| "Ville Du Havre" | 820 liters | 650 hp | BL |
| "Ville de Caen" | 400 liters | 645 hp | BL |
| "Ville D'Asnieres" | 300 liters | 195 hp | BL |
| "Pomone" | 175 liters | 175 hp | BL |
| "Ville de Paris" | 170 liters | 75 hp | BL |
| "Flore" | 115 liters | 65 hp | BL |
| "Ville de Maubeuge" | 70 liters | 48 hp | BL |
| "Uranus" | 2,300 liters | 520 hp | BB |
| "Bastia" | 1,900 liters | 420 hp | BB |
| "300 CK" (3) | 1,900 liters | 420 hp | BB |
| "RC 200" | 1,500 liters | 160 hp | BB |
| "Pic Epeiche" | 1,500 liters | 400 hp | BG |
| "Manitowoc 4500" | 3,500 liters | 450 hp | BG |
| "Banias" | 2,000 liters | 490 hp | BG |

**Louis M. Piriou, Moulin a Fouler, 29229 Ploumoguer**

| | | | |
|---|---|---|---|
| "Le Ferlas" | — | 660 hp | S |
| "Le Roselier" | — | 640 hp | S |

**Ponts et Chausses de Bayonne, 64100 Bayonne**

| | | | |
|---|---|---|---|
| "Bayonne" | — | 2,100 hp | S |

**Port Autonome Du Havre Terre-Plein De La Barre Le Havre B.P. 1413 76067**

| | | | |
|---|---|---|---|
| "Robert Peyronnet" | 730 cu. m./7 cu. m. | 2,160 kW | GH |
| "Claude Chazy II" | 800 mm | 5,225 kW | CS |
| "Al. de la Mailleraye" | 425 liters | 190 kW | BL |
| "Ponton-grue G.F. 9" | 1,525 liters | 200 kW | BG |

**Port Autonome De Rouen, 34, Boulevard de Boisbuilbert, 76037 Rouen Cedex**

| | | | |
|---|---|---|---|
| "Paul Barrilon" | 4,000 cu. m. | 12,975 hp | TH |
| "Cressenval" | 16 in. | 720 hp | CS |
| "DR 2" | 800 liters | 465 hp | BL |
| "Val de Seine" | 800 L | 1,562 hp | BL |

Alain Gauthier—managing director;

**Port Authority of Bordeaux, 2, Place Gabriel 33075, Bordeaux Cedex, Tel.: (56) 90.91.21. Telex: 550 266 BACAPORT-BORDX**

| | | | |
|---|---|---|---|
| "Francois Leveque" | 4,000 cu. m. | 7,000 hp | TH |
| "Pierre Durepaire" | 1,340 cu. m. | 5,040 hp | TH |
| "Pierre-Henry Watier" | 1,340 cu. m. | 5,040 hp | TH |

**Port Autonome de Nantes—Saint Nazaire, 2, Place de L'Edit de Nantes, B.P. 1053, 44037 Nantes Cedex**

| | | | |
|---|---|---|---|
| "Rene Siegfried" | 1,500 cu. m. | 7,000 hp | TH |
| "Montoir de Bretagne" | | 3,500 hp | CS |
| "La Loire" | | 700 hp | BD |
| "La Slack" | 250 cu. m. | 1,400 hp | GH |

**Robert Michel, Ste. Gemme Cadevil, 17600 Saujon**

| | | | |
|---|---|---|---|
| "Nathalie" | — | 1,500 hp | S |

**Sabliers de L'Atlantique, Zone Portuaire de Monitoir de Bretagne, 44500 Montoir**

| | | | |
|---|---|---|---|
| "Corsen" | — | 500 hp | S |

**Sainrapt et Brice—3-5, Av. Gallieni, 94250 Gentilly, Paris**

| | | | |
|---|---|---|---|
| "Abu Dhabi" | 24 in. | 2,300 hp | CS |
| "Brisar" | 24 in. | 2,300 hp | CS |
| "Relai" | 24 in. | 2,300 hp | CS |
| "Sabrice" | 24 in. | 2,300 hp | CS |

**Service Maritime des Ports de Boulogne S/MER et De Calais 96, Quai Gambetta B.P. 689 62321 Boulogne-Sur-Mer Cedex**

| | | | |
|---|---|---|---|
| "Maxime Outrey" | 44 x 800 L | 2 x 460 hp | BL |
| "Liane" | 250 cu. m. | 2 x 300 hp | BG |

**Societe Cooperative de Draguage d'Armement & des Travaux Public, Terre plein Nord de L'Ecluse, 1700 La Rochelle-Pallice**

| | | | |
|---|---|---|---|
| "La Cordee" | — | 360 hp | SH |

**Societe Exploration Calcaire Marine (SECMA) Siege Zone Industrielle, Pontrieux 22**

| | | | |
|---|---|---|---|
| "Eric Cooper" | 20 in. | 625 hp | SH |

**Societe International de Dragages et de Travaux Hydrauliques PVW s.a. Rue de la Verrerie, Chemin de Halage, 60200 Margny Les Compiegne, Tel. 33.4-4830422, Telex: 066+150+193+**

*(See PVW International Dredging and Harbor Works, The Netherlands).*

**Societe Nationale De Travaux De Dragage (S.N.T.D.) 54, Rue de Courcelles, 75008 Paris**

**Full ownership**

| | | | |
|---|---|---|---|
| "Concorde" | 26 in. | 5,120 hp | CS |
| "Lillo" | 12 in. | 500 hp | CS |
| "Hercules" | 27 tons | | Rockbreaker |
| "Europa" | 20 tons | | Rockbreaker |

**Joint ownership—S.N.T.D. and Dredging International**

| | | | |
|---|---|---|---|
| "Atlantique" | 6,400 cu. yds. | 8,440 hp | TH |
| "Pantagruele" | 2,630 cu. yds. | 4,875 hp | TH |
| "Mascaret" | 30 in. | 7,600 hp | CS |
| "Lamproie" | 26 in. | 2,300 hp | CS |

**Societe Pte. Derrien-Bichue, P.O. Box 99, Lannion, 22300**

| | | | |
|---|---|---|---|
| "Sir Cedric" | — | 275 hp | S |

**Societe Services et Transports 7, Place Leon-Meyer, 76600 Le Harve**

| | | | |
|---|---|---|---|
| "La Nive" | — | 1,280 hp | SH |
| "Sare" | — | 1,280 hp | SH |
| "Socoa" | — | 1,280 hp | SH |

**Societe TIMAC., P.O. Box 56, 35403, Saint Malo**

| | | | |
|---|---|---|---|
| "Muriel" | 12 in. | — | CS |

**Sodranord S.A.R.I. Centre d'Affaires de Paris—Nord Immeuble Le Continental Boite Postale 267 93153 Le Blenc Meshil Cedex**

*(See HAM, The Netherlands).*

**Travaux Maritimes Hydrauliques, hanger No. 1 Quai Nord 17—La Pallice**

| | | | |
|---|---|---|---|
| "Vlaanderen III" | 750 cu. yds. | — | TH |

**Union Maritime De Dragage—UMD, 1 Rue de Craiova, 92024 Nanterre Cedex**

| | | | |
|---|---|---|---|
| "Jean Rigal" | 33 in. | 10,635 hp | CS |

| | | | |
|---|---|---|---|
| "Cap Martin" | 32 in. | 7,525 hp | CS |
| "Ajao Kuta" | 16 in. | 2,100 hp | CS |
| "Lokoja" | 16 in. | 2,100 hp | CS |
| "Kourou" | 16 in. | 1,990 hp | CS |
| "Ame" | 14 in. | 1,055 hp | CS |
| "Charles Belleville" | 1,200 cu. m. | 5,550 hp | TH |

**Zanen (France) S.A.R.L., Rond Point 93, 65, Rue du General Gallieni, 93107 Montreuil Cedex Paris, Tel.: (1) 8587484; Telex: 213039 zanen p**
*(See Zanen Verstoep N.V., The Netherlands).*

## FRENCH WEST INDIES

**Jorges Bernard, Box 4, Saint Martin, Guadaloupe**

| | | | |
|---|---|---|---|
| HS "No. 1" | 10 in. | — | CS |
| HS — | 1½ cu. yds. | — | BC |

## GABON

**Zanen Gabon S.A., P.O. Box 336 Libreville. Tel: 700092 Telex: 5395 Plooije go**
*(See Zanen Verstoep N.V., The Netherlands).*

## GAMBIA

**Government of the Republic of Gambia, The Quadrangle, Banjul.**

| | | | |
|---|---|---|---|
| "Falo" | 85 cu. m. | 230 hp | GH |

## EAST GERMANY

**VEB Bagger-, Bugsier-u., Bergungsreederei, Uberseehafen Postfach 16, DDR-25000, Rostock.**

| | | | |
|---|---|---|---|
| "Anklam" | — | 600 hp | BG |
| "Barth" | — | 600 hp | BG |
| "Greifswald" | — | 2,640 hp | BG |
| "Ostsee" | 700 cu. m. | 3,600 hp | TH |
| "Wolgast" | — | 2,640 hp | BG |

## WEST GERMANY

**Bagger-und Bauunternehmung Delta GmbH., 10, Zum Panrepel, 2800 Bremen 44**
*(See Royal Boskalis Westminster Group N.V., The Netherlands).*

**Brewaba Wasserbaugesellschaft, Bremen mah Bennigsenstr. 2-6, 2800 Bremen 1**
*(See Hollandsche Aanneming Maatschappij bv, The Netherlands).*

**Philipp Holzmann AG, P.O. Box 132082, Mittelweg 9, 2000 Hamburg 13**

| | | | |
|---|---|---|---|
| "Keto" | 23.6 in. | 5,473.5 hp | TH |
| "Argo" | 17.7 in. | 2,929.5 hp | TH |
| "Hercules" | 35.4 cu. ft. | 1,600 hp | BL |
| "Titan" | 33.8 cu. ft. | 1,300 hp | BL |
| "Triton" | 31.5 cu. ft. | 900 hp | BL |
| "Ajax" | 5.3 cu. ft. | 228 hp | BL |
| "Achilles" | 5.3 cu. ft. | 228 hp | BL |
| "Bettina" | 158.9 cu. ft. | 903 hp | BG |
| "Peter" | 61.8 cu. ft. | 240 hp | BG |
| "Hannes" | 56.5 cu. ft. | 125 hp | BG |
| "Konrad" | 56.5 cu. ft. | 125 hp | BG |
| "Harry I" | 105.9 cu. ft. | 990 hp | BB |
| "Harry II" | 141.3 cu. ft. | 700 hp | BD |
| "Spuler V" | 27.56 cu. ft. | 9,100 hp | CS |
| "Falco" | 27.56 in. | 7,859.5 hp | CS |
| "Spuler VIII" | 27.56 in. | 6,948.3 hp | CS |
| "Spuler III" | 25.6 in. | 2,500 hp | CS |
| "Cross River State" | 20.0 in. | 1,511 hp | CS |
| "River State" | 18.0 in. | 1,511 hp | CS |
| "Spuler VII" | 15.7 in. | 1,280 hp | CS |
| "Trischen" | 15.7 in. | 570 hp | CS |
| "Edward" | 12.0 in. | 466 hp | CS |
| "Gerhard" | 12.0 in. | 466 hp | CS |
| "Nkemdemin" | 12.0 in. | 466 hp | CS |
| "Adeleuwa" | 12.0 in. | 466 hp | CS |
| "Blauort" | 15.7 in. | 1,290 hp | S |

**Franz & Joachim Minthe Kg., Gassnerallee 20, Postfach 783, 6500 Mainz**

| | | | |
|---|---|---|---|
| "No. 1" | 260 cu. yds./hr. | — | BL |
| "No. 3" | 260 cu. yds./hr. | — | BL |
| "No. 2" | 150 cu. yds./hr. | — | BL |
| "No. 4" | 100 cu. yds./hr. | — | BL |
| "Polyp" | 400 cu. yds./hr. | — | BG |

**Bilfinger & Berger Nassbaggerei, GmbH, 2000 Hamburg 76, Winterhder Weg 27**

| | | | |
|---|---|---|---|
| "Langeland" | 32 in. | 10,338 hp | CS |
| "Gotland" | 32 in. | 10,338 hp | CS |
| "Helgoland" | 26 in. | 4,910 hp | CS |
| "Ameland" | 26 in. | 5,000 hp | CS |
| "Seeland" | 26 in. | 4,338 hp | CS/S |
| "Lolland" | 26 in. | 3,300 hp | CS |
| "Falkland" | 26 in. | 3,300 hp | CS |
| "Neuland" | 26 in. | 3,300 hp | CS |
| "Dixie" | 20 in. | 1,450 hp | CS |
| "Wiesbaden" | 5,700 cu. yds. | 9,600 hp | TH |
| "Friesland" | 34 cu. ft. | 1,580 hp | BL |
| "Jutland" | 28 cu. ft. | 950 hp | BL |

BBN undertakes all types of international dredging and reclamation projects. BBN belongs to the Bilfinger & Berger group, international civil engineering contractors, with associates and offices in Germany, Turkey, Egypt, Libya, Nigeria, Liberia, USA, Saudi Arabia, Indonesia, Venezuela, and Iraq.

**Hansestadt Bremisches Amt, Bussestrasse 27, 2850 Bremerhaven, 1**

| | | | |
|---|---|---|---|
| "Spuler Wesser" | — | 1,835 hp | TH |

**Hochtief Nassbaggergesellschaft MBH (HTN) Contrescarpe 45, 2800 Bremen 1**

| | | | |
|---|---|---|---|
| "Wado" | 8,230 cu. yds. | 10,000 hp | TH |
| "Transmundum I" | 3,900 cu. yds. | 2,480 hp | TH |
| "HT-102" | 22 in. | 1,640 hp | CS |

This company was established in 1969 in Bremen and executes international projects and operations world-wide in the trailing suction hopper field. They are a 100% subsidiary of Hochtief AG in Essen (West Germany)—one of the leading civil engineering and construction groups in Europe, having an international reputation.

**P.V.W. Hafen-, Wasser- und Tiefbau GmbH, 2800 Bremen 1, Neidenburgerstrasse 17-111-OG, Postbox 102512, Phone: 49.421-449097/8/9, Telex: 245371**
*(See PVW International Dredging and Harbour Works. The Netherlands).*

**Wasser-und Schiffahrtsdirektion Bremen, Franzinek 5, 2800 Bremen**

| | | | |
|---|---|---|---|
| "Ludwig Franzius" | 3,000 cu. m. | 6,000 hp | TH |

**Wasser-und Schiffahrtsdirektion Hamburg, Bernhard-Nocht-Strasse 78, 2000 Hamburg, 4**

| | | | |
|---|---|---|---|
| "Johannes Gahrs" | 2,800 cu. m. | 4,800 hp | TH |

## GHANA

**Dunkwa Goldfield Ltd., P.O. Box 128, Tarkiva**

| | | | |
|---|---|---|---|
| "No. 1" | 6 cu. ft. | — | BL M |
| "No. 2" | 6 cu. ft. | — | BL M |
| "No. 3" | 6 cu. ft. | — | BL M |

## GREECE

**Archirodon, 15, Akadimias Street, Athens**

| | | | |
|---|---|---|---|
| "Ionion" | 765 cu. m. | 850 hp | TH |

**Petrola International S.A. 8, Box 2053, 8, Othonos Street, Athens**

| | | | |
|---|---|---|---|
| "Petrola 39" | 36 in. | 10,000 hp | CS |
| "Petrola 29" | 30 in. | 8,000 hp | CS |
| "Petrola 49" | 26 in. | 6,000 hp | CS |
| "Trident 7" | 30 in. | 8,000 hp | CS |
| "Petrola 79" | 36 in. | 12,000 hp | CS |
| "Petrola 59" | 15 cu. yds. | — | DD |
| "Petrola 73" | 8 cu. yds. | 335 hp | BC |
| "Petrola 74" | 8 cu. yds. | 470 hp | BC |

| | | | |
|---|---|---|---|
| "Petrola 77" | 8 cu. yds. | — | BC |
| "Petrola 83" | 8 cu. yds. | 335 hp | BC |
| "Petrola 84" | 8 cu. yds. | 340 hp | BC |
| "Petrola 85" | 8 cu. yds. | 340 hp | BC |
| "Petrola 87" | 8 cu. yds. | 340 hp | BC |
| "Petrola 61" | 8 cu. yds. | 340 hp | BC |
| "Petrola 62" | 8 cu. yds. | 340 hp | BC |
| "Petrola 63" | 8 cu. yds. | 340 hp | BC |
| "Petrola 64" | 8 cu. yds. | 340 hp | BC |
| "Petrola 65" | 8 cu. yds. | 340 hp | BC |
| "Petrola 66" | 8 cu. yds. | 340 hp | BC |

Petrola International SA is a subsidiary of the John S. Latsis Group of companies, a diversified and vigorous group in many fields of business activity.

Petrola specializes in dredging and land reclamation, construction of on and offshore port facilities and naval bases. The company has completed a wide variety of projects.

In addition to the equipment listed above, the company owns six floating cranes that can be converted to eight-cubic-yard clamshell dredges, 14 split hopper barges, 11 barges and 23 other support vessels.

John S. Latsis—chairman;
Dr. Spiro J. Latsis—vice chairman;
Adm. Costas Margaritis—general manager;
Andrew Bardis—director, projects division;
Basil Korkolopoulos—director, new projects division;
Miltiades Zannos—director, dredging and equipment.

**Sourmeli Brothers, 21, Afroditis Street, Piraeus**

| | | | |
|---|---|---|---|
| "Attiki" | — | 350 hp | — |

**Triaiana Shipping Ltd., 26, Mesdogiroy, Piraeus**

| | | | |
|---|---|---|---|
| "Triena I" | — | 525 hp | S |

## GREENLAND

**Rederiet m/s Holmi ApS, 3900 Godthab**

| | | | |
|---|---|---|---|
| "Holmi" | — | 300 hp | S |

## REPUBLIC OF GUINEA

**Entreprise Guineenne de Travaux Publics & Maritimes, Boite Postale 729, Conakry**

| | | | |
|---|---|---|---|
| "Gueckedou" | 1,962 cu. yds. | — | TH |
| "A. Constantin" | 1,046 cu. yds. | — | SH |
| "Mont Nimba" | 15 cu. ft. | — | BG |

## GUYANA

**Government of The Republic of Guyana, The Harbour Master, Main Street, Georgetown, Demerara**

| | | | |
|---|---|---|---|
| "Sir Crawford" | — | 610 hp | GH |

## HONDURAS

**Naseuy Marine Enterprise S.A. P.O. Box 319, San Pedro Sula**

| | | | |
|---|---|---|---|
| "Western Warrior Anita" | 14 in. | 3,200 hp | CS |

## HONG KONG

**Andac International Ltd., 10 Harcourt Rd., Ste. 1904**

| | | | |
|---|---|---|---|
| "Kudat" | 30 in. | — | CS |
| "Petagas" | 30 in. | — | CS |

**Government of Hong Kong, Public Works Department, Marine Department, 102, Connaught Road Central**

| | | | |
|---|---|---|---|
| "Dredging No. 1" | — | 900 hp | GH |

**Green Diamond Enterprises S.A., Bank of Canton Building, 6, Des Voeux Road Central**

| | | | |
|---|---|---|---|
| "Asialane" | — | — | S |

**World Dredging Limited, Rm. 305, Peter Bldg., 58-62, Queen's Road, Central**

| | | | |
|---|---|---|---|
| "Eng Tau" | 3 cu. yds | — | BG BC |
| "Hwee Ann 31" | 3 cu. yds. | — | BG BC |
| "Han Sung 1" | 6 cu. yds. | — | BG BC |
| "St. Gerald" | 6 cu. yds. | — | BG BC |
| "St. Jean" | 6 cu. yds | — | BG BC |
| "St. Ives" | 6 cu. yds. | — | BG BC |
| "St. Marc" | 6 cu. yds. | — | BG BC |
| "St. Stephen" | 6 cu. yds. | — | BG BC |
| "U May" | 650 cu. yds. | — | BG BC |
| "Hima 1" | 6 cu. yds. | — | BG BC |
| "STB 1" | 6 cu. yds. | — | BG BC |
| "STB 5" | 6 cu. yds. | — | BC |
| "Rimau" | 10 in. | — | CS |
| "Susan" | 14 in. | — | CS |

## ICELAND

**Bjoergun Ltd., P.O. Box 4112, Saevarhoefdi 13, 124 Reykjavik, Tel.: 91-81833. Telex: 2328 Mowis is. Cable: Salvage**

| | | | |
|---|---|---|---|
| "M/V Perla" | 16 in. | 1,300 hp | SH |
| "M/V Sandey" | 20 in. | 1,900 hp | SH |
| "Sandey III" | 12 in. | 350 hp | S |

**Lighthouses and Harbours Authorities, Seljavegur 32, Reykjavik**

| | | | |
|---|---|---|---|
| "Grettir" | 4 cu. m. | — | BB |
| "Hakur" | 14 in. | — | CS |

## INDIA

**Bombay Port Trust, Shoorji Vallabhdas Marg., Ballard Estate, Fort, Bombay, 400038**

| | | | |
|---|---|---|---|
| "H.G.D. Virat" | — | 2,550 hp | GH |

**Calcutta Port Trust, 15, Strand Road, Calcutta, 700001**

| | | | |
|---|---|---|---|
| "Bhagirathi" | — | 4,200 hp | TH |
| "Churni" | — | 4,200 hp | SH |
| "Grab Dredger No. 2" | — | 1,780 hp | GH |
| "Jalengi" | — | 4,400 hp | SH |
| "Mahaganga" | 4,700 cu. m. | 7,640 hp | TH |
| "Mohana" | 2,480 cu. m. | 4,900 hp | TH |
| "Pansy" | 570 cu. m. | 1,200 hp | SH |
| "Subarnarekha" | 1,274 cu. m. | 2,080 hp | TH |

**Cochin Port Trust, Administrative Office, C-IV 6th Cross Road, Willingdon Island, P.O. Box 15, Cochin, 682001**

| | | | |
|---|---|---|---|
| "Bolghatty" | 498 cu. m. | 2,120 hp | GH |
| "Gertrude Grigg" | — | — | TH |
| "Mattancherry" | 2,500 cu. m. | 2,120 hp | TH |
| "Sir Shanmukham" | — | — | TH |
| "Veluthamba" | — | — | TH |

**Dredging Corporation of India Limited, 528, Transport Bhavan, 1, Parliament Street, New Delhi 110 001, (Registered Office)**

**Head Office: Jeevan Prakash, Visakhapatnam, 530 004, Andhra Pradesh, Tel.: 64866, Telex: 0495-234**

| | | | |
|---|---|---|---|
| "M.O.T. Dredge III" | 3,450 cu. m. | 2,400 hp | TH |
| "M.O.T. Dredge V" | 3,450 cu. m. | 2,400 hp | TH |
| "M.O.T. Dredge VI" | 3,770 cu. m. | 2,400 hp | TH |
| "M.O.T. Dredge VIII" | 6,500 cu. m. | 3,800 hp | TH |
| "G.D. Sankh" | 85 cu. m. | — | TH |
| "M.O.T. Dredge I" | 560 mm | 850 hp | CS |
| "M.O.T. Dredge II" | 560 mm | 850 hp | CS |
| "M.O.T. Dredge IV" | 800 mm | 4,500 hp | CS |
| "M.O.T. Dredge VII" | 800 mm | 4,500 hp | CS |

**Government of the Republic of India (Maharashta State), Sachivalaya, 400001**

| | | | |
|---|---|---|---|
| "Agasti" | — | 720 hp | CS |

**Kandla Port Trust, P.O. Box 50, Gardnidham Gujarat 370201**

| | | | |
|---|---|---|---|
| "S.D. Kandla" | 800 cu. m. | 1,220 hp | TH SH |
| "M.D. Kutch Vallabh" | 2,500 cu. m. | 2,970 hp | TH |

**Madras Port Trust, Rajavi Salai, Madras, Tamil Nadu PIN: 600 001**

| | | | |
|---|---|---|---|
| "Coleroon" | 1,111 cu. m. | 1,930 hp | TH |
| "Cauvery" | 850 cu. m | 1,860 hp | TH |
| "Wenlock" | 110 cu. m. | 220 hp | GH |

**Paradip Port Trust, Paradip, 754142**

| | | | |
|---|---|---|---|
| "Konarka" | — | 1,578 hp | TH |

**Tuticorin Port Trust, Tuticorin, 628004**

| | | | |
|---|---|---|---|
| "Tuticorin" | — | 900 hp | TH |

**United Shippers & Dredgers Ltd., 67/2 Lavelle Road, Bangalore, 560001**

| | | | |
|---|---|---|---|
| "Triveni" | 150 cu. m./hr. | 350 hp | CS |
| "Sangam" | 150 cu. m./hr. | 350 hp | CS |
| "Bhavani" | 150 cu. m./hr. | 250 hp | CS |
| "Sharavati" | 20 in. | — | CS |
| "Krishna" | 2 cu. m./hr. | — | BC |

United Shippers & Dredgers was established in 1971 as a public limited company, and is the first organization of its kind in the private sector of India's composite economy.

Admiral R.D. Katari, Indian Navy (ret.)—chairman;
Col. A.N. Sethi, AVSM (ret.)—Indian Army Corps of Engineers, general manager (operations);
Lt. Col. Gkk Iyengar KC (ret.)—Indian Army Corps of Engineers, manager, projects & commercial;
O.P. Makhija—president.

**Visakhapatnam Port Trust, Visakhapatnam, Andhra Pradesh, 530001**

| | | | |
|---|---|---|---|
| "H.D. Durga" | — | 495 hp | GH |
| "Varaha" | 2,500 | 3,400 hp | TH |

## INDONESIA

**Indonesian State Co. JL. Genderal Gatot, Subroto, P.O. Box 2016, Jakarta**

| | | | |
|---|---|---|---|
| "Makasar" | 90,000 cu. m./month | 860 hp | CS |
| "Enggano" | 90,000 cu. m./month | 860 hp | CS |
| "Sigembir" | 105,000 cu. m./month | 315 kva | CS |
| "D.D. Inas" | 40,000 cu. m./month | 916 hp | CS |
| "D.D. Jebus" | 40,000 cu. m./month | 789 hp | CS |
| "D.D. Bendul" | 40,000 cu. m./month | 916 hp | CS |
| "Air Putih" | 14,000 cu. m./month | 240 hp | CS |
| "Air Kah" | 22,000 cu. m./month | 280 hp | CS |
| "Selanduk" | 342,000 cu. m./month | 1,511 hp | CS |
| "Air Lanji" | 14,000 cu. m./month | 250 hp | CS |
| "Lingga" | 330,000 cu. m./month | 1,675 hp | CS |
| "Lepar" | 330,000 cu. m./month | 1,675 hp | CS |
| "D.D. Belinyu" | 90,000 cu. m./month | 1,359 hp | BL/M |
| "Belitung I" | 22 cu. ft. | 8,200 hp | BL/M |
| "Bangka II" | 22 cu. ft. | 8,200 hp | BL/M |
| "Bangka I" | 18 cu. ft. | 3,744 hp | BL/M |
| "Dendang" | 14 cu. ft. | 3,380 hp | BL/M |
| "Duyung" | 14 cu. ft. | 2,575 hp | BL/M |
| "Karimata" | 14 cu. ft. | 3,685 hp | BL/M |
| "Riau" | 14 cu. ft. | 3,685 hp | BL/M |
| "Singkep" | 14 cu. ft. | 2,506 hp | BL/M |
| "Kalmoa" | 14 cu. ft. | 2,400 hp | BL/M |
| "Menumbing" | 14 cu. ft. | 2,055 hp | BL/M |
| "Kebiang" | 14 cu. ft. | 2,515 hp | BL/M |
| "Meranteh" | 14 cu. ft. | 2,740 kva | BL/M |
| "Rasep" | 14 cu. ft. | 2,720 kva | BL/M |
| "Sungailiat" | 14 cu. ft. | 2,150 kva | BL/M |
| "Kianci" | 9 cu. ft. | 1,585 hp | BL/M |
| "Tempilang" | 9 cu. ft. | 1,525 hp | BL/M |
| "Toboali" | 9 cu. ft. | 1,600 hp | BL/M |
| "Plaben" | 9 cu. ft. | 1,095 kva | BL/M |
| "Rambat" | 9 cu. ft. | 955 kva | BL/M |
| "Sergang" | 9 cu. ft. | 1,012.50 kva | BL/M |
| "Surabaya" | 9 cu. ft. | 1,595 kva | BL/M |
| "Teriga" | 7 cu. ft. | 1,200 hp | BL/M |
| "Cerucuk" | 7 cu. ft. | 960 hp | BL/M |
| "Pring" | 7 cu. ft. | 1,500 hp | BL/M |
| "Sengkelie" | 7 cu. ft. | 960 hp | BL/M |
| "Garumedang" | 7 cu. ft. | 680 kva | BL/M |
| "Lais" | 7 cu. ft. | 680 kva | BL/M |
| "Lanji" | 7 cu. ft. | 620 kva | BL/M |
| "Rayah" | 7 cu. ft. | 680 kva | BL/M |

**Minstry of Transport, Communications and Tourism, Jakarta**

| | | | |
|---|---|---|---|
| "Sulawesi II" | 2,900 cu. m. | — | TH |

**P.T. Riau Tin Mining, S. Widjojo Centre, 5th Floor—Jalan Jenderal Sudirman 57, P.O. Box 2634—Jakarta**

| | | | |
|---|---|---|---|
| "Bima" | 30 cu. ft./850 L | 7,040 hp | BL/M |

Company is owned by:
Bicciton Int'l. Metals, The Netherlands.

**P.T. Sac Nusantara, Lina Building Jln H.R., Rasuna Said, KaV B7, Kuningan, Jakarta Selatan**

| | | | |
|---|---|---|---|
| "Sacna I" | 14 in./16 in. | 1,210 hp | CS |
| "Sacna II" | 12 in. | 680 hp | CS |
| "Sacna IV" | 16 in./18 in. | 1,250 hp | CS |
| "Sacna V" | 18 in. | 1,480 hp | CS |
| "Sacna VI" | 16 in./18 in. | 1,21 hp | CS |
| "Sacna VII" | 16 in. | 1,480 hp | CS |
| "Sacna VIII" | 12 in. | 450 hp | CS |
| "Sacna IX" | 16 in. | 1,480 hp | CS |
| "Sacna X" | 27 in. | 5,000 hp | CS |
| "Sacna XI" | 16 in. | 1,440 hp | CS |
| "Sacna XII" | 16 in. | 1,440 hp | CS |
| "BSC I" | 10 in./12 in. | 360 hp | S |
| "BSC II" | 16 in. | 850 hp | S |
| "Krasacna I" | 6 cu. yds. | 335 hp | BC |
| "Krasacna II" | 7 cu. yds. | 580 hp | BC |

P.T. Sac-Nusantara was established in 1971 as a general contracting company specializing in dredging of harbors, access channels, fairways, river dredging for flood control, reclamation of land for industrial areas, construction of dikes, submarine pipe laying or pulling and similar projects.

P.T. Sac-Nusantara is fully owned by Indonesian Nationals.

**P.T. Mercu Agung Sakti Jln.P., Jaya Karta 46, Blok D/17 Jakarta, Tel.: 624391, Telex: 41239 JAF**

| | | | |
|---|---|---|---|
| "Mercu I" | 24 in. | — | CS |
| "Mercu II" | 24 in. | — | CS |

## IRAQ

**Iraqi Ports Administration, Basrah**

| | | | |
|---|---|---|---|
| "Alkhalij Alarabi" | 3,000 cu. m. | 9,000 hp | TH |
| "Alnajaf" | 3,000 cu. m. | 9,000 hp | TH |
| "Almerbid" | 3,000 cu. m. | — | TH |
| "Alzubair" | 3,000 cu. m. | — | TH |
| "Unknown" | 600 cu. m. | — | TH |
| "Al Mosul" | — | — | BG |
| "Hillah" | 3,850 cu. m. | 8,740 hp | SH |
| "CO 852" | 3,000 cu. m. | 7,860 hp | SH |
| "CO 853" | 3,000 cu. m. | 7,860 hp | SH |

**H. Mahmood J. Al-Bunnia & Sons, Al-Bunnia Bldg., Jumhouriya Str., Baghdad**

| | | | |
|---|---|---|---|
| "No. 3" | 14 in. | — | CS |
| "No. 4" | 14 in. | — | CS |
| "No. 1" | 12 in. | — | CS |
| "No. 2" | 12 in. | — | CS |

## IRELAND

**Commissioners of Public Works in Ireland, St. Stephen's Green, Dublin 2**

| | | | |
|---|---|---|---|
| "Little Dragon" | 8 in. | 190 hp | CS |

**Cork Harbor Commissioners, Customs House St., Cork**

| | | | |
|---|---|---|---|
| "Loughmahon II" | 15 cu. ft. | — | BL |
| "Ringacoltig" | 600 | — | GH |

**Drogheda Harbor Commissioners, Drogheda**

| | | | |
|---|---|---|---|
| "Tredagh" | 250 tons | — | SH |
| "D.H.C. Grab" | 140 tons | — | BG |

**Dublin Port & Docks Board, East Wall, Dublin 1**

| | | | |
|---|---|---|---|
| "Mudfisher 2" | 70 cu. ft. | — | BG |
| "Sandfisher" | 160 cu. ft. | — | BG |

**Holland Dredging Co. (IRL) Ltd., Pembroke House, Pembroke Street, Cork**

*(See Holland Dredging Co. Ltd., The Netherlands)*

**Irish Dredging Company Ltd., Mainport Monahah Road, Cork**
*(See Royal Boskalis Westminster Group N.V., The Netherlands)*

**Limerick Harbour Commissioners, Harbour Office, Limerick**

| | | | |
|---|---|---|---|
| "Curraghgour II" | 400 tons | 550 hp | HS BG |

**New Ross Harbor Commissioners, New Ross, Co. Wexford**

| | | | |
|---|---|---|---|
| "New Ross 4" | 750 cu. m. | — | BG |

**PVW Ireland Dredging & Harbour Works, Ltd., Gas Lane Malahide Co. Dublin, Tel.: 353.1-451447, Telex: 96–50031134+**
*(See PVW International Dredging & Harbour Works, Hasselt, The Netherlands)*

**Waterford Harbor Commissioners, Harbor Office, Waterford**

| | | | |
|---|---|---|---|
| "Portlairge" | 475 tons | — | BG S |

## ITALY

**Compagnia Costruzioni Generali S.p.A—Via Paisiello, 26 00198 Rome**

| | | | |
|---|---|---|---|
| "Venezia" | 28 in. | 4,000 hp | CS |
| "Augusta" | 500 liters | 750 hp | BL |
| "Aretusa" | 900 liters | 1,400 hp | BL |
| "Iblea" | 900 liters | 1 400 hp | BL |

**Covalca Italiana S a.a., Piazza Rossetti 4-14, 16149 Genoa**

| | | | |
|---|---|---|---|
| "Sorocaima" | 660 | 1,016 hp | TH CS |

**Edmondo Denotti, Quartu S, Elena, 09100 Cagliari, Sardinia**

| | | | |
|---|---|---|---|
| "Citta Di Quartu S. Elena" | | 220 hp | — |

**Fincosit, Via Fieschi 6, 16121 Genoa**

| | | | |
|---|---|---|---|
| "Fincosita" | 1,200 cu. m. | 1,120 hp | TH CS |

**Geolidro S.p.A., Viale Toschi, 43100 Parma**

**Impresa Roberto Almagia, 17 Via in Lucina, 00186 Rome**

| | | | |
|---|---|---|---|
| "Palombina" | 1,300 cu. yds. | 2,000 hp | TH CS |
| "Pomposa" | 30 in. | 7,000 hp | CS |

**Ministero dei Lavori Pubblici Ufficio del Genio Civile per le Opere Maritime Venez, Sestiere di Santa Croce 1307, 30125 Venice**

| | | | |
|---|---|---|---|
| "Francesco Morosini" | — | 776 hp | — |
| "Giuseppe Di Vittorio" | — | 1,500 hp | SH |

**Ministry of Public Works, Special Office for the Po, Parma, 43100**

| | | | |
|---|---|---|---|
| "Fratelli" | — | — | — |
| "Rosselli" | 356 mm | 1,800 hp | SD |

**"Motia" Compagnia di Navigazione S.p.A., Piazetta Bagnasco 7, 90141 Palermo, Sicily**

| | | | |
|---|---|---|---|
| "Ada" | — | 1 050 hp | S |

**Societa Italiana Dragaggi S.p.A., 33 Via della Ferratella, 00184 Rome**

| | | | |
|---|---|---|---|
| "San Tomas Secondo" | 4 398 cu. yds. | 7,372 hp | TH |
| "DS 216" | 24 in | 2,160 hp | CS |
| "Maria Carolina" | 30 in. | 8,300 hp | CS |
| "DS 212" | 22 in. | 2,300 hp | CS |
| "Lia" | 8 cu. yds. | 1,100 hp | BD |

**S.I.D.E.R.—Societa Italiana Dragaggi Escavazioni Rocciose—S.p.A. Via in Lucina n° 17—00186 Rome**

| | | | |
|---|---|---|---|
| "Ravenna" | 20 in. | 1,300 hp | CS |
| "Pasqualina" | 12 in. | 500 hp | CS |
| "Posidone" | 3 cu. yds. | 500 hp | BG |
| "Pater Sprivs" | 8 cu. yds. | — | BG |

**Joint ownership:**

| | | | |
|---|---|---|---|
| "Pantagruele" | 2.600 cu. yds. | 6.875 hp | TH |

S.I.D.E.R.-S.p.A. is a limited company which is part of the Almagia group established in 1867.

The head office organization is formed by the top management and the following departments: proposal and marketing, tender and calculations job supervision, supply and expediting, financial and accounting, personnel and general services. The job organization is headed by a project manager and is formed by experienced engineers and skilled specialists.

Ing. Edoardo Almagia—president and general manager;
Dott. Giorgio Arbarello—managing director;
Ing. Enrico Gagliardi—managing director;
Ing. Giovanni Magello—technical director.

**SIDERSARDA—Societa Sarda di Dragaggi e Escavazioni Rocciose—S.p.A. Via Cagliari n° 320—09025 Oristano**

| | | | |
|---|---|---|---|
| "Pater Sardus" | 9 cu. ft. | 294 hp | BG |

**Joint ownership:**

| | | | |
|---|---|---|---|
| "Palombina" | 1.300 cu. yds. | 3.125 hp | TH |
| "Pantagruele" | 2.600 cu. yds. | 6.050 hp | TH |
| "Asia" | 32 21 cu. ft. | 955 hp | BL |
| "Pomposa" | 30 in. | 7,000 hp | CS |

## JAMAICA

**Construction & Dredging Ltd., 7-9 Harbor St., Kingston**

| | | | |
|---|---|---|---|
| "Chimera" | 27 in. | — | CS |

**Jamaica Dredging Co. Ltd., P.O. Box 98, 248 Spanish Town Road, Kingston 11**

| | | | |
|---|---|---|---|
| "Tallawah" | 12 in. | 850 hp | CS |

## JAPAN

**Aoki Construction Co., Ltd., 4-15 Oyodo-minami 1-chome, Oyodo-ku, Osaka**

| | | | |
|---|---|---|---|
| "SC 1100 Bulldozer" | 3-5 cu. m. | — | BG |

**Bulldozer Construction Co. Ltd., 5, 1, Minami, Oyodo-cho, Oyodo-ku, Osaka**

| | | | |
|---|---|---|---|
| "SC 1100 Bulldozer" | 3-5 cu. m. | — | BG |

**Chiba Kaiji Kogyo K.K., 6-8, Kado-waki-cho, 2-chome, Ishinomaki, Miyagi Perfecture**

| | | | |
|---|---|---|---|
| "Tomofuku Maru No. 3" | — | 1,000 hp | — |

**Goyo-Ballast Co., Ltd., 2-8, Koraku 2-chome, Bunkyo-ku, Tokyo 112. (A joint venture of Penta-Ocean Construction Co., Ltd. and Ballast-Nedam Groep N.V., The Netherlands).**

| | | | |
|---|---|---|---|
| "Dejima" | 34 in. | — | S |

**Harbor Bureau, Tokyo Metropolitan Office, Tokyo**

| | | | |
|---|---|---|---|
| "Amagi Go" | 630 cu. m. hr | — | BL |

**Honma Gumi Co. Ltd., 3301, Misu-cho, Nishi-Minatomachi-Dori, Niigata City**

| | | | |
|---|---|---|---|
| "No. 2 Echigo" | 25 in. | — | CS |

**Japan Industrial Land Development Co. Ltd., (J.I.L.D.) 9-15, 1-chome, Kaigan, Minato-ku, Tokyo 105**

| | | | |
|---|---|---|---|
| "Kokuei Maru" | 30 in. | 8,000 hp | CS |
| "Alameda No. 2" | 30 in. | 8,000 hp | CS |
| "Alameda" | 30 in. | 8 000 hp | CS |
| "Aoki Maru" | 25 in. | — | CS |

Japan Industrial Land Development Co., Ltd. was established in 1960 and engages in land reclamation works, and dredging works in ports and harbors in Japan and abroad.

In 1977 the company divided into two organizations—Japan Resources Corp., which is the parent company and engages in offshore oil and natural resources on a worldwide basis, and Japan Industrial Land Development Co., Ltd.

Mineo Nakamichi—president;
Susumu Hayakawa—vice president;
Isamu Yamashita—senior managing director;
Hiroshi Taniguchi—technical director;
Takeshi Noguchi—director.

**Ministry of Transport, Japanese Government, Bureau of Ports and Harbors, Kasumigaseki, Chiyoda-ku, Tokyo**

| | | | |
|---|---|---|---|
| "Kaiho Maru" | 2.052 cu. m. | 4.800 ps | TH |
| "Seiryu Maru" | 1.754 cu. m. | 6.000 ps | TH |
| "Hakusan Maru" | 1.355 cu. m. | 2.800 ps | TH |
| "Daisen Maru" | 373 cu. m. | 600 ps | TH |
| "No. 2 Chinzei Maru" | 800 cu. m. hr. | 1.000 ps | BD |
| "Noge Maru" | 800 cu. m. hr. | 800 ps | BD |
| "Chinzei Maru" | 630 cu. m. hr. | 1.000 ps | BD |
| "Oseto Go" | 8 cu. m. | 1.650 ps | BD |
| "Raijin" | 4 cu. m. | 1.000 ps | BD |
| "Kanmon Go" | 3 cu. m | 800 ps | BD |
| "Gassan Maru" | 6 cu. m. | 1 350 ps | BG |
| "Kazusa Maru" | 13 cu. m. | 1.800 ps | BG |
| "Kurohime Maru" | 4 cu. m. | 640 ps | BG |
| "Sado Go" | 4 cu. m. | 640 ps | BG |
| "Musashi Go" | 4 cu. m | 640 ps | BG |
| "Settsu Go" | 4 cu. m. | 680 ps | BG |

| | | | |
|---|---|---|---|
| "Zao Maru" | 4 cu. m. | 640 ps | BG |
| "Nagato Go" | 4 cu. m. | 650 ps | BG |

**Mitsui Harbour and Urban Construction Co., Ltd., Shinjuku Mitsui Bldg., Nishi-Shinjuku 2-chome, Shinjuku-ku, Tokyo, 160**

**Subsidiary companies:**
**Nihon Kigyo Kaisha Ltd.**

**2-1, Takanawa, Minato-ku, Tokyo**

| | | | |
|---|---|---|---|
| "Daikoku Maru" | 33 in. | 10,000 hp | CS |
| "San Ei Maru No. 18" | 30 in. | 5,000 hp | CS |
| "San Ei Maru No. 17" | 27 in. | 4,500 hp | CS |
| "San Ei Maru No. 16" | 27 in. | 4,000 hp | CS |
| "Asakura Maru No. 12" | 27 in. | 4,000 hp | CS |
| "San Ei Maru No. 11" | 27 in. | 3,000 hp | CS |
| "Koryu Maru" | 23 in. | 2,250 hp | CS |
| "San Ei Maru No. 8" | 25 in. | 2,000 hp | CS |
| "San Ei Maru No. 5" | 23 in. | 1,800 hp | CS |
| "San Ei Maru No. 3" | 23 in. | 1,500 hp | CS |
| "Shoryu Maru No. 2" | — | 1,300 hp | BG |
| "Shoryu Maru" | — | 640 hp | BG |

**Penta-Ocean Construction Co., Ltd., 2-8 Koraku, 2-chome, Bunkyo-ku, Tokyo, 112**

| | | | |
|---|---|---|---|
| "Suruga" | 30.0 in. | 16,900 hp | CS |
| "Suez No. 3" | 30.0 in. | 16,900 hp | CS |
| "Suez No. 5" | 30.0 in. | 16,900 hp | CS |
| "Suez No. 7" | 30.0 in. | 15,760 hp | CS |
| "Pacific" | 30.0 in. | 12,630 hp | CS |
| "Gulf" | 30.0 in. | 12,530 hp | CS |
| "Taisei" | 30.0 in. | 7,230 hp | CS |
| "Suez" | 30.0 in. | 7,370 hp | CS |
| "Taisei No. 2" | 30.0 in. | 6,730 hp | CS |
| "Kooshiyo" | 26.4 in. | 5,735 hp | CS |
| "Asama" | 26.4 in. | 5,735 hp | CS |
| "Koosei" | 26.4 in. | 5,735 hp | CS |
| "Nippon Maru" | 26.4 in. | 5,750 hp | CS |
| "Hodaka" | 26.4 in. | 5,730 hp | CS |
| "Hodaka No. 2" | 26.4 in. | 5,730 hp | CS |
| "Fuyo No. 6" | 26.4 in. | 5,730 hp | CS |
| "Seto" | 26.4 in. | 4,548 hp | CS |
| "Hooei" | 24.0 in. | 3,830 hp | CS |
| "Refresher No. 3" | 15.7 in. | 3,245 hp | CS |

January 1896—Founded as a civil engineering "Mizuno-Gumi" in Kure, Japan.

April 1929—Established Mizuno-Gumi Unlimited Partnership.

January 1954—Incorporated Mizuno-Gumi Co., Ltd.

August. 1961—Awarded Suez Canal Improvement Work in International tender.

February 1967—The company name was changed to the present "Penta-Ocean Construction Co., Ltd." (Goyo Kensetsu Kabushiki Kaisha).

December 1974—Awarded Suez Canal Expansion project amounting to a total of Y108,000 million (US-S514 million).

June 1979—Entered into a cooperation agreement with Sea Tank Co., France for construction of offshore oil drilling concrete platforms.

Company officials are:
Tetsutaro Mizuno—chairman;
Rempei Mizuno—president;
Hiroshi Kuwata—executive vice president;
Tokio Imanaka—executive vice president;
Joji Tanaka—director, overseas projects.

The types of work are dredging and reclamation, highway, tunnel and bridge construction, construction of dams and improvement works of rivers, agricultural engineering, other civil works, piers, mooring facilities and architecture.

**Rinkai Construction Co., Ltd., 3-8, 2 chome, Shiba, Minato-ku, Tokyo**

| | | | |
|---|---|---|---|
| "Kashii-Maru" | 30 in. | 10,600 hp | CS |
| "Taga-Maru" | 28 in. | 6,000 hp | CS |
| "Ikuta-Maru" | 25 in. | 3,900 hp | CS |
| "Kasuga-Maru" | 30 in. | 3,400 hp | CS |
| "Ikoma-Maru" | 25 in. | 3,300 hp | CS |
| "Uchito-Maru" | 25 in. | 3,250 hp | CS |
| "Suminoe-Maru" | 30 in. | 2,500 hp | CS |
| "Yashio-Maru" | 22 in. | 2,400 hp | CS |
| "Aioi-Maru" | 30 in. | 2,200 hp | CS |
| "Hakusan-Maru" | 22 in. | 2,000 hp | CS |
| "Yashima-Maru" | 22 in. | 2,200 hp | CS |
| "Yaegaki-Maru" | 16 in. | 1,000 hp | CS |
| "Kimitsu-Maru" | 14 in. | 2,000 hp | CS |
| "Hie-Maru" | 12 in. | 450 hp | CS |
| "Hidaka-Maru" | 12 in. | 450 hp | CS |
| "Yagumo-Maru" | 12 in. | 310 hp | CS |
| "Yasaka-Maru" | 12 in. | 310 hp | CS |
| "Kisago-Maru" | 22 in. | 2,470 hp | S |
| "Takasago-Maru" | 22 in. | 1,600 hp | S |
| "Hakuryu-Maru" | 14 in. | 650 hp | CS |
| "Amatsu-Maru" | 12 in. | 580 hp | S |
| "Kairyu-Maru" | 16 in. | 870 hp | S |
| "Oura-Maru" | 12 in. | 310 hp | S |
| "Satsuki-Maru No. 3" | 16 cu. m. | 1,800 hp | BG |
| "Kaede-Go" | 10 cu. m. | 1,000 hp | BG |
| "Rinkai No. 3" | 8 in. | 300 hp | CS |

**Saeki Kensetsu Kogyo Co. Ltd., Morita Bldg., 50, 2-chome, Bingomachi, Higashi-ku, Osaka, 541**

| | | | |
|---|---|---|---|
| "Kinsen-Maru" | 28 in. | 4,000 hp | CS |
| "Taiju-Maru" | 28 in. | 4,000 hp | CS |
| "Taisei-Maru" | 25 in. | 3,200 hp | CS |
| "Kinto-Maru" | 25 in. | 1,500 hp | CS |
| "Kaneyoshi-Maru" | 23 in. | 1,500 hp | CS |
| "Kinyo-Maru" | 23 in. | 1,500 hp | CS |
| "Kinryu-Maru" | 23 in. | 1,200 hp | CS |
| "Kinyu-Maru" | 19 in. | — | CS |
| "Kinju-Maru" | 16 in. | — | CS |
| "Kinkai-Maru" | 12 in. | — | CS |
| "Yamato No. 6" | 13 cu. yds. | — | BG |
| "Yamato No. 5" | 5.2 cu. yds. | — | BG |
| "Yamato No. 7" | 4 cu. yds. | — | BG |
| "Yamato No. 8" | 4 cu. yds. | — | BG |
| "Yamato No. 3" | 2.8 cu. yds. | — | BG |
| "Yamato No. 1" | 2.5 cu. yds. | — | BG |
| "Yamato No. 2" | 1.4 cu. yds. | — | BG |

Saeki Kensetsu Kogyo Co., Ltd. was established in 1917. The company is a leading general contractor in Japan and is noted for its port and harbor construction, as well as other kinds of marine works.

**Toa Harbor Works Co., Ltd., 5, Yonban-cho, Chiyoda-ku, Tokyo 102**

| | | | |
|---|---|---|---|
| "Ryowa-Maru No. 3" | 34 in. | 15,760 hp | CS |
| "Asia-Maru" | 30 in. | 11,090 hp | CS |
| "Asia-Maru No. 3" | 30 in. | 13,720 hp | CS |
| "Asia-Maru No. 2" | 30 in. | 9,940 hp | CS |
| "Fukoku-Maru No. 5" | 28 in. | 6,600 hp | CS |
| "Totai-Maru" | 28 in. | 7,128 hp | CS |
| "Fuyo-Maru No. 3" | 28 in. | 5,840 hp | CS |
| "Fuyo-Maru No. 5" | 28 in. | 7,600 hp | CS |
| "Tachibana-Maru" | 28 in. | 5,780 hp | CS |
| "Tachibana-Maru No. 2" | 28 in. | 7,510 hp | CS |
| "Toshin-Maru" | 26 in. | 4,000 hp | CS |
| "Asahi-Maru No. 3" | 26 in. | 3,600 hp | CS |
| "Azuma-Maru No. 3" | 22 in. | 3,396 hp | CS |
| "Tosei-Maru" | 22 in. | 2,000 hp | CS |
| "Tajima-Maru" | 15 in. | 400 hp | CS |
| "Toa Ketam" | 3.5 cu. m. | — | BG |
| "Clean Up No. 2" | 15 in. | 350 hp | S |
| "Clean Up No. 3" | 18 in. | 300 hp | S |
| "Clean Up No. 5" | 8 in. | 50 hp | S |

**Tokushi Shunsetsu Co. Ltd.**

| | | | |
|---|---|---|---|
| "Tokushun Maru No." | 4,000 cu. m. | — | TH |

During the 70 years since its founding, Toa Harbor Works Co., Ltd., has been engaged in various aspects of marine construction growing rapidly, until today it holds the top position in this field in Japan.

At the same time the company has broadened its area of operations to include general construction, where an excellent reputation has been established. Toa now applies its knowledge and experience of construction technology to the construction of roads, bridges, tunnels, railroads, buildings and various other industrial projects.

Principal officials are:
Suejiro Nakagome—chairman;
Makoto Norisugi—president;
Hiroshi Yamana—executive vice president;
Kenkichi Tsutsui—executive vice president;
Ichiro Tsuda—executive vice president.

**Toyo Construction Co. Ltd., 7-1, 3-chome, Kandanishikicho, Chiyoda-ku, Tokyo 101**

| | | | |
|---|---|---|---|
| "Rokko-Maru" | 29.5 in. | 12,000 hp | CS |
| "Chiyoda-Maru" | 29.5 in. | 8,000 hp | CS |
| "Tsukuba-Maru" | 29.5 in. | 8,000 hp | CS |
| "Getsuyo-Maru" | 25.6 in. | 4,000 hp | CS |
| "Kayo-Maru" | 25.6 in. | 4,000 hp | CS |
| "Suiyo-Maru" | 25.6 in. | 4,000 hp | CS |
| "Mokuyo-Maru" | 25.6 in. | 4,000 hp | CS |
| "Suzuka-Maru" | 25.6 in. | 3,650 hp | CS |
| "Doyo-Maru" | 25.6 in. | 3,120 hp | CS |
| "Matsushima-Maru" | 24.0 in. | 2,200 hp | CS |
| "Taian-Maru No. 2" | 22.0 in. | 2,400 hp | S |
| "Taian-Maru" | 17.6 in. | 1,590 hp | S |
| "Oozer No. 1" | 7.8 in. | 240 hp | S |
| "Tosei-Go No. 12" | 20.8 cu. yds. | 1,800 hp | BG |
| "Toyo-Go No. 2" | 5.2 cu. yds. | 330 hp | BG |
| "Toyo-Go No. 1" | 5.2 cu. yds. | 300 hp | BG |

**Yano Kensetsu K.K., 20-1 Kyo-machi, Ikuta-ku, Kobe, Myogo Prefecture**

| | | | |
|---|---|---|---|
| "Yano-Maru No. 12" | — | 1,300 hp | — |

## KENYA

**Diving Contractors Ltd., (DIVECON), Box 98574, Mombasa**

| | | | |
|---|---|---|---|
| "Aardvark" | 12 in. | 465 hp | CS |

## KOREA

**Korea Dredging Corporation, 47-1 Shin Heung Dong 3GA, Choong-Ku, Inchon, 160, Korea**

| | | | |
|---|---|---|---|
| "Han Yang P-1" | 30 in | 18,300 hp | CS |
| "Han Yang P-2" | 28 in. | 4,400 hp | CS |
| "Han Yang P-3" | 28 in | 3,300 hp | CS |
| "Han Yang P-4" | 24 in | 2,250 hp | CS |
| "Han Yang P-5" | 20 in. | 2,200 hp | CS |
| "Han Yang P-6" | 20 in. | 1,200 hp | CS |
| "Han Yang P-7" | 20 in. | 1,200 hp | CS |
| "Han Yang P-8" | 20 in. | 1,200 hp | CS |
| "Han Yang P-10" | 30 in. | 3,600 hp | CS |
| "Han Yang P-11" | 24 in | 2,250 hp | CS |
| "Han Yang P-12" | 20 in. | 1,200 hp | CS |
| "Han Yang G-1" | 16 cu. yds. | 1,600 hp | BC |
| "Han Yang G-2" | 10 cu. yds. | 910 hp | BC |
| "Han Yang G-3" | 10 cu. yds. | 720 hp | BC |
| "Han Yang G-4" | 5 cu. yds. | 320 hp | BC |
| "Han Yang G-5" | 5 cu. yds. | 220 hp | BC |
| "Han Yang G-6" | 2½ cu. yds. | 160 hp | BC |
| "Han Yang G-7" | 2½ cu. yds. | 160 hp | BC |
| "Han Yang G-8" | 1½ cu. yds. | 165 hp | BC |
| "Han Yang G-9" | 1½ cu. yds. | 165 hp | BC |
| "Han Yang G-10" | 1½ cu. yds. | 165 hp | BC |
| "Han Yang G-11" | 1½ cu. yds. | 150 hp | BC |
| "Han Yang G-12" | 1½ cu. yds. | 165 hp | BC |
| "Han Yang G-13" | 1½ cu. yds. | 165 hp | BC |
| "Han Yang G-15" | 1½ cu. yds. | 129 hp | BC |

Short history of company: Date incorporated: August 16, 1967 (government enterprise); Switch-over to private enterprise: November 24, 1981. Positive achievement of business: Reclamation: about 1,000 ha. Dredging: Our company fills domestic needs.

Types of work: dredging and reclamation of harbor and public waters; public works and overseas construction; shipbuilding; lease and repairs maintenance of heavy equipment; purchase, sales and lease of real estate.

Company officials are:
Yoo Ho Moon—president;
Chung Kun Tek—managing director;
Kim Jong Won—management director;
Shin Haeng Sun—engineering director;
Moon Young Tak—manager of planning dept.;
Choi, Maeng Chul—manager of engineering dept.

**Sam Hyup Development Co., Ltd., No. 1, 1-ka, Dongkwang-dong, Jung-ku, Busan**

| | | | |
|---|---|---|---|
| "Junha Ho" | — | 2,000 hp | CS |
| "Samhyup Ho" | — | 720 hp | BG |

## KUWAIT, STATE OF

**Gulf Dredging Co. (S.A.K.), P.O. Box 24054, Safat, Kuwait**

| | | | |
|---|---|---|---|
| "Mubarak" | 35 in | 12,250 hp | CS |
| "Arefjan" | 26 in | 4,240 hp | CS |
| "Al Kassar" | 2.5 cu. m. | — | BD |

Gulf Dredging Company was officially formed on 8th December 1975, as a local company to satisfy the growing needs for dredging capacity in the Middle East and has dredged well over 20 million cubic meters within Kuwait; Engages in dredging projects in the Arabian Gulf, Red Sea, Gulf of Suez and Gulf of Aqaba. Its activities comprise of: excavation dredging, maintenance dredging, hydraulic filling, sand and gravel winning, hydrographic survey, soil investigation and other construction work, such as sheet piling and construction of breakwaters.

Company executives are:
Maher Marafie—chairman;
Abdullah Abdul Noor Jamal—vice-chairman;
Fadel Abu Abbas—general manager.

## LIBYA

**Department of Ports & Lights, Damascus Street, P.O. Box 648, Tripoli**

| | | | |
|---|---|---|---|
| "Algela" | — | 1,260 hp | BG |

**Oasis Oil Co. of Libya Inc., P.O. Box 395, Tripoli**

| | | | |
|---|---|---|---|
| "Intasar" | — | — | CS |

## MALAYSIA

**Director of Marine Peninsular Malaysia, P.O. Box 12, Port Kelang**

| | | | |
|---|---|---|---|
| "Tanjong Pinang" | — | 360 hp | — |

**Director of Marine-West Malaysia, Marine Headquarters, P.O. Box 12, Port Kelang**

| | | | |
|---|---|---|---|
| "Gannet" | — | 160 hp | SH |
| "Tanjong Dungun" | — | 720 hp | GH |
| "Tanjong Gemuroh" | — | 720 hp | SH |

**Osborne & Chappel International Sdn. Bhd., P.O. Box 67, Ipoh, Perak**

**Kinta Kellas Tin Dredging Co. PLC**

| | | | |
|---|---|---|---|
| "Batu Gajah Perak" | 151,400 cu. m. month | 750 kW | BL M |

**Mambang Di-Awan Sdn. Bhd.**

| | | | |
|---|---|---|---|
| "Kampar, Perak" | 137,600 cu. m. month | 912 kW | BL M |

**Penang Port Commission, King Edward Place, P.O. Box 143, Penang**

| | | | |
|---|---|---|---|
| "Kuala Prai" | — | 990 hp | GH |

**Pengkalen Ltd.**

| | | | |
|---|---|---|---|
| "Lahat Perak" | 151,400 cu. m. month | 820 kW | BL M |

**Petaling Tin, Berhad**

| | | | |
|---|---|---|---|
| "No. 7 Kuia Langat, Selangor" | 367,000 cu. m. month | 3,200 kW | BL M |

| | | | |
|---|---|---|---|
| "No. 9 Kuala Langat, Selangor" | 660,600 cu. m./month | 3,580 kW | BL/M |

**Tanjong Tin Dredging Ltd.**

| | | | |
|---|---|---|---|
| "Tanjong Tualang, Perak" | 240,800 cu. m./month | 1,714 kW | BL/M |

**Pacific Tin Consolidated Corp., Box 292, Kuala Lumpur 01-02, Selangor**

| | | | |
|---|---|---|---|
| "No. 8 Batang Berjuntai" | 420,000 cu. yds./month | 20 cu. ft. | BL/M |
| "No. 2 Sungei Tinggi" | 210,000 cu. yds./month | | BL/M |

**Conzinc Riotinto (M) Sdn. Bhd., P.O. Box 2591, Kuala Lumpur, Selangor**

| | | | |
|---|---|---|---|
| "SRI Timah" | 24 cu. ft. | 5,000 hp | BL |
| "SRI Dengkil" | 24 cu. ft. | 5,110 hp | BL |

Company personnel include:
Barney Oh Choo Lye—dredging superintendent;
Mahalingam Sambamoorthy—electrical engineer;
Abdul Aziz bin Attan—mine accountant;
Kamarudin bin Tompang—dredgemaster;
Tan It Beng—mine planning engineer.

**Pernas Charter Management Sdn. Berhad, Wisma Bunga Raya, 152, Jalan Ampang, P.O. Box 936, Kuala Lumpur, 01-02**

**Aokam Thai Ltd.**

| | | | |
|---|---|---|---|
| "No. 2" | 240,000 cu. yds./month | 1,828 hp | BL/M |
| "No. 3" | 320,000 cu. yds./month | 2,416 hp | BL/M |

**Austral Amalgamated Tin Berhad**

| | | | |
|---|---|---|---|
| "Lower Perak No. 2" | 580,000 cu. yds./month | 2,548 hp | BL/M |
| "Lower Perak No. 1" | 510,000 cu. yds./month | 2,295 hp | BL/M |

**Ayer Hitam Tin Dredging Malaysia, Berhad**

| | | | |
|---|---|---|---|
| "No. 1 Puchong" | 320,000 cu. yds./month | 4,349 hp | BL/M |
| "No. 2 Puchong" | 550,000 cu. yds./month | 5,257 hp | BL/M |
| "No. 3 Puchong" | 340,000 cu. yds./month | 3,838 hp | BL/M |

**Berjuntai Tin Dredging Berhad**

| | | | |
|---|---|---|---|
| "No. 1 Batang Berjuntai" | 354,000 cu. yds./month | 2,132 hp | BWS |
| "No. 2 Batang Berjuntai" | 360,000 cu. yds./month | 1,487 hp | BL/M |
| "No. 3 Batang Berjuntai" | 360,000 cu. yds./month | 1,870 hp | BL/M |
| "No. 4 Batang Berjuntai" | 360,000 cu. yds./month | 1,770 hp | BL/M |
| "No. 5 Batang Berjuntai" | 320,000 cu. yds./month | 1,644 hp | BL/M |
| "No. 6 Batang Berjuntai" | 620,000 cu. yds./month | 3,230 hp | BL/M |
| "No. 7 Batang Berjuntai" | 750,000 cu. yds./month | 4,762 hp | BL/M |
| "No. 8 Batang Berjuntai" | 750,000 cu. yds./month | 4,470 hp | BL/M |
| "No. 9 Batang Berjuntai" | 750,000 cu. yds./month | 4,675 hp | BL/M |

**Bidor Malaya Tin Sdn. Berhad**

| | | | |
|---|---|---|---|
| "No. 1 Bidor" | 330,000 cu. yds./month | 1,871 hp | BL/M |
| "No. 2 Bidor" | 400,000 cu. yds./month | 2,438 hp | BL/M |
| "No. 3 Bidor" | 400,000 cu. yds./month | 2,381 hp | BL/M |
| "No. 4 Bidor" | 400,000 cu. yds./month | 2,874 hp | BL/M |

**Kamunting Tin Dredging Limited**

| | | | |
|---|---|---|---|
| "No. 5 Taiping" | 190,000 cu. yds./month | 1,413 hp | BL/M |
| "No. 6 Sri Matang Taiping" | 305,000 cu. yds./month | 2,426 hp | BL/M |

**Kramat Tin Dredging Berhad**

| | | | |
|---|---|---|---|
| "Tapah Road, Perak" | 300,000 cu. yds./month | 1,993 hp | BL/M |

**Kuala Kampar Tin Fields Berhad**

| | | | |
|---|---|---|---|
| "No. 2 Malim Nawar" | 420,000 cu. yds./month | 2,292 hp | BL/M |

**Lower Perak Tin Dredging Berhad**

| | | | |
|---|---|---|---|
| "No. 1 Sungei Luas" | 400,000 cu. yds./month | 2,350 hp | BL/M |

**Malayan Tin Dredging (M) Berhad**

| | | | |
|---|---|---|---|
| "No. 2 Kampong Gajah" | 520,000 cu. yds./month | 2,434 hp | BL/M |
| "No. 3 Kampong Gajah" | 550,000 cu. yds./month | 2,348 hp | BL/M |
| "No. 4 Kampong Gajah" | 460,000 cu. yds./month | 2,569 hp | BL/M |
| "No. 7 Kampong Gajah" | 650,000 cu. yds./month | 4,384 hp | BL/M |
| "No. 8 Kampong Gajah" | 400,000 cu. yds./month | 2,392 hp | BL/M |

**Tronoh Mines Malaysia Berhad**

| | | | |
|---|---|---|---|
| "No. 1 Ayer Kuning" | 400,000 cu. yds./month | 3,025 hp | BL/M |
| "No. 2 Ayer Kuning" | 410,000 cu. yds./month | 3,440 hp | BL/M |

**Southern Kinta Consolidated Limited**

| | | | |
|---|---|---|---|
| "Southern Kampar—Perak" | 440,000 cu. yds./month | 2,220 hp | BL/M |
| "Bernam No. 1—Perak" | 360,000 cu. yds./month | 1,643 hp | BL/M |
| "Bernam No. 2—Perak" | 360,000 cu. yds./month | 1,968 hp | BL/M |
| "Bernam No. 3—Perak" | 400,000 cu. yds./month | 2,465 hp | BL/M |

**Southern Malayan Tin Dredging (M) Berhad**

| | | | |
|---|---|---|---|
| "No. 1 Tanjong Tualang" | 200,000 cu. yds./month | 1,610 hp | BL/M |
| "No. 2 Tanjong Tualang" | 350,000 cu. yds./month | 1,446 hp | BL/M |
| "No. 3 Tanjong Tualang" | 300,000 cu. yds./month | 1,517 hp | BL/M |
| "No. 4 Degong Road" | 360,000 cu. yds./month | 2,444 hp | BL/M |
| "No. 5 Tanjong Tualang" | 450,000 cu. yds./month | 2,138 hp | BL/M |
| "No. 6 Degong Road" | 400,000 cu. yds./month | 2,856 hp | BL/M |

**Syarikat Lombong Sebina Johor Sdn. Berhad**

| | | | |
|---|---|---|---|
| "No. 1" | 200,000 cu. yds./month | 1,330 hp | BL/M |

**Timah Dermawan Sdn. Berhad**

| | | | |
|---|---|---|---|
| "No. 1 Ayer Kuning" | 710,000 cu. yds./month | 4,730 hp | BL/M |

**Tongkah Harbour Limited**

| | | | |
|---|---|---|---|
| "Bhuket—Thailand" | 180,000 cu. yds./month | 1,362 hp | BL/M |

**St. Piran Mining Co. Ltd.**
*(See U.K. listing).*

**Selangor Dredging Berhad, Dengkil Via Kajang, Selangor**

| | | | |
|---|---|---|---|
| "Kuala Langat No. 1" | 480,000 cu. yds./month | 2,829 hp | BL/M |
| "Kuala Langat No. 2" | 864,000 cu. yds./month | 4,971 hp | BL/M |

## MEXICO

**Cia. Exploradora del Istmo S.A., Apartado Postal 293, Coatzacoalcos, Ver**

| | | | | |
|---|---|---|---|---|
| "Buena Vista" | 10 in. | 900 hp | | CS |

**Construcciones Fluviales y Maritimas S.A. de C.V., Carr. Mty., Saltillo Km. 339, Santa Catarina, N.L. (Division of Construcciones Protexa, Monterrey)**

| | | | | |
|---|---|---|---|---|
| "Margarita" | 24 in. | 3,645 hp | | CS |
| "Maya" | 24 in. | 3,235 hp | | CS |
| "Magdalena" | 20 in. | 1,700 hp | | CS |
| "Cristina" | 20 in. | 1,490 hp | | CS |
| "Dolores" | 16 in. | 920 hp | | CS |
| "Laura" | 16 in. | 1,491 hp | | CS |
| "Rosy" | 14 in. | 933 hp | | CS |
| "Margarita II" | 18 in. | 935 hp | | CS |
| "Don Mario" | 3.5 cu. yds. | 400 hp | BG | BC |
| "Don Javier" | 6 cu. yds. | 410 hp | BG | BC |
| "Don Humberto" | 5 cu. yds | 400 hp | BG | BC |
| "Torreon" | 3.5 cu. yds. | 400 hp | BG | BC |
| "Tampico" | 3.5 cu. yds. | 400 hp | BG | BC |

Company officials are:
Arnoldo Gallont—dredging director;

Guillermo Trevino—purchasing manager;
Arturo Morales—maintenance manager;
Luis Herrera—operating manager.

**Direccion General De Dragado, Baja California No. 255—Edificio "A", 8° Piso, D.F.**

| | | | |
|---|---|---|---|
| "Guadalupe Victoria" | 35.5 in. | 5,715 hp | CS TH |
| "Cristobal Colon" | 26 in. | 7,022 hp | TH CS |
| "Presidente Madero" | 23.5 in. | 6,995 hp | TH |
| "Presidente Juarez" | 23.5 in. | 6,995 hp | TH |
| "Puebla" | 23.5 in. | 6,860 hp | TH |
| "Chiapas" | 23.5 in. | 7,040 hp | TH |
| "Tabasco" | 23.5 in. | 6,850 hp | TH |
| "Presidente Cardenas" | 23.5 in. | 3,100 hp | TH |
| "Presidente Elias Calles" | — 23.5 in. | — 3,100 hp | — TH |
| "Frontera" | 14 in. | 2,159 hp | TH |
| "Papaloapan" | 14 in. | 2,149 hp | TH |
| "Morelos" | 27 in. | 4,950 hp | CS |
| "V. Carranza" | 27 in. | 6,540 hp | CS |
| "Nueva 20" | 20 in. | 1,645 hp | CS |
| "Guaymas" | 20 in. | 1,606 hp | CS |
| "Anahauc" | 20 in. | 2,120 hp | CS |
| "Baja California" | 20 in | 1,508 hp | CS |
| "Mazatlan II" | 20 in. | 1,490 hp | CS |
| "Nueva 16-I" | 16 in. | 1,215 hp | CS |
| "Nueva 16-II" | 16 in. | 1,215 hp | CS |
| "Melchor Ocampo" | 16 in. | 880 hp | CS |
| "Quintana Roo" | 16 in. | 1,969 hp | CS |
| "Panuco" | 16 in. | 1,980 hp | CS |
| "Yukalpeten" | 16 in. | 1,215 hp | CS |
| "Salina Cruz" | 16 in. | 1,148 hp | CS |
| "Laguna Del Carpintero" | — 12 in. | — 842 hp | — CS |
| "San Pedrito" | 12 in. | 750 hp | CS |
| "Grijalva" | 6 in. | 85 hp | CS |
| "Usumacinta" | 6 in | 46 hp | CS |

**Obras Portuarias de Mexico, S.A., Insurgentes Sur. No. 453-243, Mexico 11, D.F.**

| | | | |
|---|---|---|---|
| "No. 1" | 16 in. | — | CS |

**Petroleos Mexicanos, Gerencia de Marina, AV. Marina Nacional No. 329, Edificio 1917-2° Piso, Col Anahuac, Mexico 17, D.F.**

| | | | |
|---|---|---|---|
| "Pemex No. 702" | 10 in. | — | CS |

**Secretaria de Communicaciones y Transportes—Direccion General de Dragado, 6° Piso, Insurgentes Sur 664, Col. de Valle, Mexico City**

| | | | |
|---|---|---|---|
| "Vera Cruz II" | — | — | CS |

## MOROCCO

**Government of Morocco, Casablanca**

| | | | |
|---|---|---|---|
| "Yperlee" | 900 cu. yds. | — | TH |

**Direction DRAGAGE—R.A.P.C., Boulevard des Almohades, Casablanca**

| | | | | |
|---|---|---|---|---|
| "Maamora" | 31.5 in. | 900 cu. m. | 3,600 hp | TH |
| "Gueltat Zemmour" | 23.6 in | 750 cu. m. | 2,065 hp | TH |
| Bir Anzarane" | 23.6 in. | 750 cu. m. | 2,065 hp | TH |
| "Gharbia" | 23.6 in. | 500 cu. m. | 1,515 hp | SH |

**Taissir Chaufour-Dumez, 5, Rue Yves Gay, Casablanca**

| | | | |
|---|---|---|---|
| "Taissir II" | 15 cu. ft. | 425 hp | BL |

## MOZAMBIQUE

**Servicos de Dragagens, D.S. Marinha, Lourenco Marques**

| | | | |
|---|---|---|---|
| "GOA" | 1,500 cu. m. | 3,500 hp | TH |
| "Pungoe" | 800 cu. m. | 2,200 hp | TH CS |
| "Buzi" | 800 cu. m. | 2,000 hp | TH CS |
| "Matola" | 800 cu. m. | 2,000 hp | TH CS |
| "Comandante Herz" | 600 cu. m. | 2,000 hp | TH CS |
| Adolfo Loureiro" | 700 cu. m. | 1,000 hp | TH |
| "Umbeluzi" | 24 in | 1,500 hp | CS |
| "Angela" | 0 850 cu. m. | — | BG BC |
| "Trafaria" | 0.750 cu. m. | — | BG BC |

## NETHERLANDS

**Amsterdam Ballast Dredging, P.O. Box 500, 2 laan van Konenburg, 1180 be Amstelveen, (Division of Ballast-Nedam Groep N.V.)**

| | | | |
|---|---|---|---|
| "Humber River" | 12,500 cu. yds. | 16,000 hp | TH |
| "Oranjestad" | 5,500 cu. yds. | 6,120 hp | TH |
| "Willemstad" | 4,200 cu. yds. | 7,200 hp | TH |
| "Liesbosch" | 1,000 cu. yds. | 3,060 hp | TH |
| "Queen of Holland" | 44 in. | 7,200 hp | CS |
| "New Amsterdam" | 32 in. | 7,400 hp | CS |
| "Rozenburg" | 26 in. | 1,700 hp | CS |
| "Utrecht" | 26 in. | 1,700 hp | CS |
| "Ijsselmeer" | 28 in. | 2,200 hp | S |
| "Blijkpolder" | 26 in. | 1,500 hp | S |
| "Ijmuiden II" | 22 in. | 600 hp | S |
| "Schellingwoude" | 27 in. | 3,500 hp | S |
| "Overijssel" | 20 in. | 900 hp | S |
| "Triton" | 26 cu. ft. | 400 hp | BL |
| "Rhea" | 26 cu. ft. | 400 hp | BL |
| "Nereus" | 16 cu. ft. | 200 hp | BL |

*(See, also, the dredges in the combined fleets of NATCO i.e., North American Trailing Company [Illinois] and Goyo Ballast Co., Ltd. [Japan]).*

**Ballast Transport, Hoogeind 7, Driebruggen**

| | | | |
|---|---|---|---|
| "Geertje" | 1,000 cu. yds. | — | SH |

**Bilfinger + Berger Dredging B.V. Nijverheidsweg 37, 2102 LK Heemstede, The Netherlands**

*(See Bilfinger + Berger Nassbaggerei GmbH, West Germany).*

**Billiton International Metals B.V., Louis Couperusplein 19, 2514 HP 's Gravenhage**

| | | | |
|---|---|---|---|
| "Bima" | 30 cu. ft. | — | BL M |

**Blankenvoort & Zoon Aanneming mij., Mollaan 3, 2061 CR Bloemendaal**

| | | | |
|---|---|---|---|
| "Orca" | — | — | CS |

**Boskalis Oosterwijk B.V., 399-405 's-Gravenweg, 3065 SB Rotterdam**

*(See Royal Boskalis Westminster N.V.).*

**Boskalis Westminster Baggeren B.V., 20, Rosmolenweg, 3356 LK Papendrecht**

*(See Royal Boskalis Westminster N.V.).*

**Boskalis International B.V., 20, Rosmolenweg, 3356 LK Papendrecht**

*(See Royal Boskalis Westminster N.V.)*

**Breejenbout B.V., Cearalaan 26, P.O. Box 8, 2050 AA, Overveen**

| | | | |
|---|---|---|---|
| "Cornelia" | 8,400 cu. yds. | — | TH |
| "Kinhem" | 1,050 cu. yds. | — | TH |
| "Johanna Jacoba" | 4,850 cu. yds. | — | TH |
| "Linquenda I" | 26 in. | — | CS |
| "Linquenda II" | 26 in. | — | CS |
| "Linquenda III" | 26 in. | — | CS |
| "Rhone" | 20 in. | — | CS |
| "Albis" | 30 in. | — | S |
| "Batavus" | 41 in. | — | S |
| "Mosa" | 30 in. | — | S |
| "Rhenus" | 28 in. | — | S |
| "Scaldis" | 28 in. | — | S |
| "Isala" | 30 in. | — | S |
| "Atlas" | 29 cu. ft. | — | BL |
| "Hermes" | 29 cu. ft. | — | BL |
| "Hector" | 15 cu. ft. | — | BL |
| "Labor I" | 15 cu. ft. | — | BL |

Baggermaatschappij Breejenbout B.V., established about 130 years ago, specializes in the construction of new harbors, deepening and maintenance works of approach channels, etc. During the past few years two new trailing hopper suction dredges have been added to the fleet, and a third is under construction.

Management personnel are:
H.W.J. den Breejen van den Bout—director;
J.J. Fischer—director;
J.W. Ludwig, M.Sc.—director;

**Joh. Boele B.V., 2931AK, Middelland 59, Krimpen aan de Lek, Phone: (01807), (16066), Telex: 26179, Zagrini**

| | | | |
|---|---|---|---|
| "Eridani" | 2,027 cu. yds. | 3,620 hp | TH |
| "Fomalhaut" | 2,354 cu. yds. | 3,720 hp | TH |
| "Gemma" | 2,276 cu. yds. | 3,300 hp | TH |
| "Karab" | 1,962 cu. yds. | 2,270 hp | TH |
| "Lyra" | 2,590 cu. yds. | 3,417 hp | TH |
| "Mira" | 2,590 cu. yds. | 3,417 hp | TH |
| "Betelgeuze"* | 1,519 cu. yds. | 1,286 hp | SH |
| "Zagri 23" | 1,254 cu. yds. | 1,200 hp | SH |
| "Taurus" | 887 cu. yds. | 1,634 hp | GH |
| "T. Boele Senior" | 28 in. | 1,865 hp | S |
| "Orion"* | 24 in. | 1,760 hp | S |
| "Polaris"* | 24 in. | 2,040 hp | S |
| "Eurostroom" | 4 cu. yds. | 285 hp | BG |
| "Eurogeul" | 4 cu. yds. | 305 hp | BG |

* registered in Belgium

Joh. Boele B.V. was founded in 1953 by Johannes Boele, who is still president and general manager, assisted by his sons Ing. S. Boele and Ir. T. Boele. The company specializes in maintenance dredging of harbor entrances, channels, ports and rivers all over Europe.

All trailing suction hopper dredges have a discharge system for pumping into shore terminals.

Joh. Boele B.V. is an important supplier in Holland of sand for roads and dikes. The company has a subsidiary in Belgium.

**Broekhoven B.V., Dredging Contractors, P.O. Box 149—3700 AC Zeist/Boulevard 12—3707 BM, Zeist**

| | | | |
|---|---|---|---|
| "Wado" | 6,300 cu. m. | 11,000 hp | TH |
| "Apollo" | 4,800 cu. m. | 11,200 hp | TH |
| "Poseidon" | 4,800 cu. m. | 10,130 hp | TH |
| "Transmundum I" | 3,000 cu. m. | 5,620 hp | TH |
| "Castor" | 850 mm | 15,600 hp | CS |
| "Pollux" | 850 mm | 7,510 hp | CS |
| "Triton" | 650 mm | 4,600 hp | CS |
| "Aegir" | 600 mm | 2,700 hp | CS |
| "Nereus" | 600 mm | 2,300 hp | CS |
| "HT-102" | 550 mm | 1,640 hp | CS |
| "Jason" | 500 mm | 1,200 hp | CS |
| "Janus" | 500 mm | 1,200 hp | CS |
| "Hercules" | 650 mm | 4,420 hp | S |
| "Faunus" | 700 mm | 2,000 hp | S |
| "Haarlem" | 600 mm | 1,630 hp | S |
| "Schiphol" | 600 mm | 1,660 hp | BL |
| "Ajax" | 700 L | 615 hp | BL |
| "Nestor" | 425 L | 450 hp | BL |

Broekhoven B.V., established in 1894, is a fully owned subsidiary of Hochtief AG, one of the leading civil engineering and construction groups in Europe. The company, with offices in Denmark, West Germany, the United Kingdom, Belgium, France, India, Indonesia, Pakistan and the Philippines, specializes in dredging of ports and harbors and harbor entrances, reclamation of land for industrial areas, construction of dikes and similar projects.

**Costain-Blankevoort International Dredging Company Limited, P.O. Box 1, 2060 AA, Bloemendaal, Holland, Tel.: 023-258321, Telex: 41160 Cobla nl Telecopier: 023 273 305**

| | | | |
|---|---|---|---|
| "Alpha Bay" | 4,700 cu. m. | 12,215 hp | TH |
| "Gamma Bay" | 2,500 cu. m. | 5,960 hp | TH |
| "Global Bay" | 30 in. | 9,830 hp | CS |
| "Deira Bay"* | 22 in. | 3,500 hp | CS |
| "Dubai Bay" | 22 in. | 3,195 hp | CS |
| "Garhoud Bay"* | 22 in. | 3,500 hp | CS |
| "Jebel Ali Bay" | 30 in. | 10,400 hp | CS |
| "Jumeira Bay" | 30 in. | 10,400 hp | CS |
| "Maktoum Bay"* | 30 in. | 10,400 hp | CS |
| "Zabeel Bay"* | 30 in. | 10,400 hp | CS |

Costain-Blankevoort International Dredging Company Limited belongs to the Costain-Blankevoort Group of Dredging Companies, using COBLA—the abbreviation of Costain-Blankevoort—as a trade name. COBLA operates a notable and well balanced fleet of modern dredges to which additions are constantly being made. COBLA's dredges have been used all over the world to create harbors and approach channels, to reclaim and create land, to strip overburden for mining operations, to win aggregate from the sea and to dig trenches for underwater pipelines.

**Den Herder, Westkanaalweg 59, 4424 BG Wemeldinge**

| | | | |
|---|---|---|---|
| "Saeftinge" | — | 1,400 hp | TH |

**Dredging V02 B.V., 1, Oude Haven P.O. Box 10, 3984ZG Odijk, Tel.: (0) 3405-61144, Telex: 47566 (Oord hl)**

| | | | |
|---|---|---|---|
| "Volvox Hollandia" | 7,858 cu. yds. | 12,500 hp | TH |
| "Volvox Delta" | 10,463 cu. yds. | 14,600 hp | TH |
| "Volvox Frisia" | 4,458 cu. yds. | 5,032 hp | TH |

Dredging V02 B.V., member of the Van Oord Group of Odijk, the Netherlands, executes dredging jobs by means of trailing suction hopper dredges all over the world.

**Hollandsche Aanneming Maatschappij B.V. (HAM), P.O. Box 166, 2280 Ad, 4, de Bruyn Kopsstraat, 2288 EC Rijswijk**

| | | | |
|---|---|---|---|
| "HAM 350" | 1,100 cu. m. | 2,155 hp | TH |
| "Atchafalaya"* | 1,000 cu. m. | 2,788 hp | TH |
| "HAM 302" | 1,500 cu. m. | 3,040 hp | TH |
| "Mermentau"* | 1,000 cu. m. | 3,094 hp | TH |
| "Brass River I" | 2,660 cu. m. | 4,520 hp | TH |
| "HAM 306" | 2,680 cu. m. | 5,085 hp | TH |
| "W.H. Endeavour"* | 1,630 cu. m. | 5,245 hp | TH |
| "P.C.S. van Hattem" | 4,850 cu. m. | 8,266 hp | TH |
| "HAM 308" | 5,254 cu. m. | 8,266 hp | TH |
| "Mississippi"* | 2,926 cu. m. | 9,040 hp | TH |
| "W.H. Resolution"* | 4,000 cu. m. | 9,340 hp | TH |
| "HAM 309" | 4,600 cu. m. | 11,296 hp | TH |
| "Piccolo" | 8 in. | 230 hp | CS |
| "Prins Claus" | 12 in. | 450 hp | CS |
| "San Andres" | 14 in. | 1,000 hp | CS |
| "Lou Vibre" | 16 in. | 1,150 hp | CS |
| "Th. de Rooy" | 16 in. | 1,150 hp | CS |
| "Terneuzen" | 18 in. | 1,368 hp | CS |
| "Schelde" | 20 in. | 1,715 hp | CS |
| "HAM 250" | 20 in. | 1,956 hp | CS |
| "Werkendam" | 24 in. | 2,150 hp | CS |
| "HAM 251" | 20 in. | 2,601 hp | S |
| "Zeeland" | 24 in. | 3,165 hp | CS |
| "Eendracht" | 27, 5 in. | 3,203 hp | CS |
| "HAM 214" | 27, 5 in. | 4,320 hp | CS |
| "W.H. Karlye"* | 27, 5 in. | 4,320 hp | CS |
| "HAM 216" | 27, 5 in. | 5,735 hp | CS S |
| "Brabant" | 27, 5 in. | 6,552 hp | S |
| "W.H. Kunara"* | 27, 5 in. | 8,466 hp | CS |
| "HAM 217" | 33, 5 in. | 11,490 hp | CS |
| "HAM 218" | 33, 5 in. | 14,150 hp | CS |
| "HAM 112" | 800 L 500 L | — | BL |
| "HAM 113" | 800 L 500 L | — | BL |
| "VOW 102" | 5 tons | — | BG |
| "VOW 203" | 6 tons | — | BG |
| "W.H. Goomai"* | 29 tons | — | BG |
| "VOW 56" | 4 cu. m. | — | BB |
| "Popeye" | 3.6 cu. m. | — | BB |
| "Obelix" | 1.25 cu. m. | — | BB |
| "HAM 219" | 28 in. | 4,412 hp | BWS |
| "HAM 310" | 8,225 cu. m. | 16,000 hp | TH |
| "HAM 601" | 1,270 T. carrying capacity** | | |

* joint ownership

** Special purpose stone dumping vessel

HAM is an international operating company with limited liabilities. HAM is fully owned by the Hollandsche Beton Groep nv (HBG), one of the leading civil engineering contractors in the world. HBG's turnover for 1982 was Dfl. 3.232,000.000.

Since its formation in 1909, the company has been

engaged in dredging, land reclamation, underwater rockbreaking, drilling and blasting and protection (dikes, dams, breakwaters) works. Furthermore, the company deals with the supply of materials for the building industry, removal of overburden, irrigation and management services.

In the 74 years of her existence HAM has not only gained a treasure house of experience in the above-mentioned activities, but it has also built up a strong organization with subsidiaries and affiliated companies both in Holland and abroad.

Managing directors of HAM are:
G.A. van Hattem, M.Sc.;
M.K.G. Bulder, M.Sc.;
W. Vegter, M.Sc.

**Heijnen N.V. Gerb., Bosscheweg 209-213 Tilburg**

| | | | |
|---|---|---|---|
| "No. 1" | 14 in. | — | CS |
| "No. 2" | 14 in. | — | CS |

**Holland Dredging Company Ltd., Rivierdijk 219, P.O. Box 508, Hardinxveld-Giessendam, 3370 BA, Tel.: 01846-2444, Telex: dredge nl 24795**

| | | | |
|---|---|---|---|
| "Zuiderklip" | 24 in. | 2,775 hp | CS |
| "Noorderklip" | 24 in. | 2,000 hp | CS |
| "Noord-Brabant" | 24 in. | 1,740 hp | CS |
| "Holland XXVI" | 20 in. | 1,386 hp | CS |
| "Holland XVIII" | 18 in. | 1,000 hp | CS |
| "Biesbosch" | 14 in. | 680 hp | CS |
| "Den Bevert" | 24 in. | 2,675 hp | S |
| "Holland VI" | 24 in. | 1,150 hp | S |
| "Den Otter" | 24 in. | 650 hp | S |
| "Holland XXIV" | 26 in. | 1,560 hp | CS S |
| "Steurgat" | 20 in. | 1,485 hp | S |
| "Voorburg" | 18 in. | 745 hp | S |
| "Schouwen" | 18 in. | 600 hp | S |
| "Holland VIII" | 16 in. | 540 hp | S |
| "Holland X" | 14 in. | 330 hp | S |
| "Holland I" | 30 cu. ft. | — | BL |
| "Holland XVII" | 21 cu. ft. | — | BL |
| "Holland IX" | 13 cu. ft. | — | BL |
| "Holland VII" | 11 cu. ft. | — | BL |
| "Dintel" | 8.5 cu. ft. | — | BL |
| "Colossus" | 4.7 cu. ft. | — | BB |
| "Cosmos"*** | 7,030 cu. yds. | 10,400 hp | TH |
| "Neptune" | 1,700 cu. yds. | 1,450 hp | TH |

* 33-1/3%—Holland Dredging Company Ltd.

** Can also be used as oil recovery vessel.

Holland Dredging Company, founded in 1922, is an internationally operating company with offices in Holland, the United Kingdom, Ireland, France and Belgium, specializing in dredging, land reclamation, bottom and slope protection works, river crossings, and marine outfall pipelines.

Company officials are:
Ir. A.A. van Beek;
Ing. P. van der Vlies;
Ing. J. van Zandbergen.

**J.G. Nelis Materieel B.V., (and subs: v/h A. Hofman B.V.), Waarderweg 45—Postbus 802, 2003 RV Haarlem**

| | | | |
|---|---|---|---|
| "Purmerend" | 18 in. | 1,300 hp | CS |
| "Olst" | 26 in. | 1,500 hp | S |
| "Amsterdam" | 24 in. | 2,100 hp | S |
| "Hilversum" | 16 in. | 550 hp | S |
| "Bonne Chance" | 15 cu. ft. | | BL |
| "Delfzijl" | 15 cu. ft. | | BL |

**W. & A. Oosterlee, B.V., Haven 28, Maassluis**

| | | | |
|---|---|---|---|
| "Rio 5" | 12 in. | 650 hp | S |
| "Rio 4" | 12 in. | 535 hp | S |
| "Rio 3" | 18 in. | 1,065 hp | S |
| "Rio 1" | 12 in. | 480 hp | S |
| "Rio 2" | 12 in. | 500 hp | S |

**Prins Aanneming Maatschappij, B.V., P.O. Box 36, Industrieweg 24, Sliedrecht**

| | | | |
|---|---|---|---|
| "Botlek" | — | 500 hp | BL |
| "Nieuwpoort V" | 24 in. | 1,600 hp | S |
| "Gideon" | 20 in. | 1,600 hp | CS |
| "Amer" | 16 in. | 1,000 hp | CS |
| "Nautilus" | 18 in. | 1,400 hp | S |
| "Calypso" | 24 in. | 1,000 hp | S |

**PVW International Dredging & Harbour Works, P.O. Box 11, Hanzeweg 2, 8060 AA Hasselt (Ov.)**

| | | | |
|---|---|---|---|
| "Thames" | 14 in. | | TH |
| "Gelderland" | 20 in. | | S |
| "Veluwe" | 14 in. | | S |
| "Stad Hasselt" | 14 in. | | S |
| "Weser" | 500 L | | BL |
| "Schelde" | 500 L | | BL |
| "Flevo" | 400 L | | BL |
| "Rijn" | 350 L | | BL |
| "Jonge Jan II" | 175 L | | BL |
| "P.v.W. 8" | 3.5 cu. m. | | BB |
| "P.v.W. 38" | 1.5 cu. m. | | BB |
| "P.v.W. 18"* | 1,500 L | | BG BC |
| "P.v.W. 28"* | 1,500 L | | BG BC |
| "P.v.W. 48" | 5.0 cu. m. | | BB |
| "P.v.W. 58" | 2,000 L | | BG BC |
| "P.v.W. 98" | 3.5 cu. m. | | BB |
| "Hissan El Bahr" | | 1,000 hp | CS |

**Equipment available from Parent Company:**

| | | | |
|---|---|---|---|
| "Heinrich Hirdes" | 1,500 cu. m | — | TH |
| "Hansa" | 900 L | | BL |
| "Bremen" | 800 L | | BL |
| "Emden" | 650 L | | BL |
| "Roland" | 400 L | | BL |
| "Weser" | | 3,400 kW | S |
| "Kiel" | | 4,410 kW | CS |
| "Elbe II" | | 1,200 kW | CS |
| "Rhein" | | 1,620 kW | CS |
| "EMS" | | 1,500 kW | CS |
| "Nordland" | | 860 kW | CS |
| "Donau" | | 860 kW | CS |
| "Neckar" | | 904 kW | CS |
| "Mose" | | 600 kW | CS |
| "Eider" | | 730 kW | CS |
| "HH40" | | | BB |
| "HH66" | | | BB |
| "HH63" | | | BB |
| "HH68" | | | BB |
| "HH71" | | | BB |
| "HH67" | | | BB |

* self-propelled

**Robreza B.V., Ijsseldijk 351/P.O. Box 9, Krimpen a.d. Ijssel, Zuid-NL2920AA**

| | | | |
|---|---|---|---|
| "Meteoor" | 20 in. | — | S |

**Royal Boskalis Westminster N.V., 188, Baanhoek, 3360 AB Sliedrecht:**

**Subsidiary Companies:**
**Zinkcon bv, 20, Rosmolenweg, 3356 LK Papendrecht;**
**Osiris-Cesco bv, 20, Rosmolenweg, 3356 LK Papendrecht;**
**Hydronamic bv, 188a, Baanhoek, 3361 GH Sliedrecht**

**Trailing Hopper**

| | | |
|---|---|---|
| WD "Gateway" | 8,038 cu. yds. | TH |
| "Cosmos"** | 7,030 cu. yds. | TH |
| WH "Resolution"* | 5,232 cu. yds. | TH |
| WD "Seaway" | 5,197 cu. yds. | TH |
| "Beachway" | 3,990 cu. yds. | TH |
| WD "Tideway" | 3,929 cu. yds. | TH |
| WD "Mersey" | 3,532 cu. yds. | TH |
| "The Solent" | 2,850 cu. yds. | TH |
| WD "Seven Seas" | 2,849 cu. yds. | TH |
| WH "Endeavour"* | 1,995 cu. yds. | TH |
| WD "Medway" | 1,962 cu. yds. | TH |
| WD "Severn" | 1,732 cu. yds. | TH |
| WD "Hoyle" | 1,339 cu. yds. | TH |
| WD "Hilbre" | 1,269 cu. yds. | TH |
| "Dragante" | 1,046 cu. yds. | TH |
| "Henares" | 960 cu. yds. | TH |
| "Meerval" | 916 cu. yds. | TH |
| "Marinha II" | 661 cu. yds. | SH |

| | | |
|---|---|---|
| **Cutter** | | |
| "Oranje" | 35½ in. | CS |
| "Mark II" | 33½ in. | CS |
| WD "Enterprise" | 32 in. | CS |
| "Amstel" | 31½ in. | CS |
| "Jokra" | 31½ in. | CS |
| WH "Kunara"* | 31½ in. | CS |
| "Gironde" | 29½ in. | CS |
| "Gouderak" | 29½ in. | CS |
| "Para" | 29½ in. | CS |
| "Seine" | 27½ in. | CS |
| "Vecht" | 27½ in. | CS |
| WH "Karlye"* | 27½ in. | CS |
| "De Schelde" | 26 in. | CS |
| "Luydert" | 26 in. | CS |
| "Sedra I" | 26 in. | CS |
| "Wouri" | 26 in. | CS |
| "Linge" | 24 in. | CS |
| "Kelani Ganga" | 22 in. | CS |
| "Alblas" | 22 in. | CS |
| "Tejo" | 22 in. | CS |
| "Afrique" | 20 in. | CS |
| WD "Ribble" | 20 in. | CS |
| "Ville de Lome" | 20 in. | CS |
| "Eem" | 18 in. | CS |
| "Krabbe" | 18 in. | CS |
| **Suction** | | |
| "Ahoy" | 41½ in. | S |
| "Beaver MacKenzie" | 33½ in. | S |
| "Sloterdijk" | 29½ in. | S |
| "Groningen" | 26 in. | S |
| "Rijnland" | 24 in. | S |
| "Kil" | 20 in. | S |
| "Weesperkarspel" | 20 in. | S |
| "Sagitta" | 14 in. | S |
| LM "Usk" | 9 in. | S |
| **Barge Unloaders** | | |
| "Ardea" | 33½ in. | S |
| WD "Gulper" | 24 in. | S |
| "Dibden Bay" | 20 in. | S |
| "Zaan" | 20 in. | S |
| **Bucket** | | |
| "Foremost Southampton" | 28.3 cu. ft. | BL |
| "Beaver Chief" | 28.3 cu. ft. | BL |
| "Afrika" | 21.2 cu. ft. | BL |
| "Eta" | 15 cu. ft. | BL |
| "Testside" | 6 cu. ft. | BL |
| WD "Doha" | 10 cu. ft. | BB |
| WD "Challanger" | 18 cu. yds. | BG |
| WH "Goomai"* | 13 cu. yds. | BG |
| "W.G. Packman" | 11 cu. yds. | BG |
| WD "Ilajeland" | 10 cu. yds. | BG |
| WD "Swampland" | 10 cu. yds. | BG |
| WD "Burutu" | 8 cu. yds. | BG |
| "Dodo" | 8 cu. yds. | BG |
| "Pelikaan" | 8 cu. yds. | BG |
| WD "Warri" | 8 cu. yds. | BG |
| WD "Ondoland" | 7 cu. yds. | BG |
| WD "Riversland" | 7 cu. yds. | BG |
| "Dragger" | 6 cu. yds. | BG |
| "Successor" | 5 cu. yds. | BG |
| "Eendracht" | 4 cu. yds. | BG |
| "Flakkee" | 4 cu. yds. | BG |
| "Flamingo" | 4 cu. yds. | BG |
| "Maraboe" | 4 cu. yds. | BG |
| "Merwede" | 4 cu. yds. | BG |
| WD "Nigeria" | 4 cu. yds. | BG |
| "Sloe" | 3 cu. yds. | BG |
| "Tilbury Toiler" | 3 cu. yds. | BG |

* 1/2 Interest
** 1/3 Interest

The Royal Boskalis Westminster Group, with more than 40 subsidiaries, undertakes dredging contracts from prefeasibility studies, site investigations and design to the completion of turnkey projects.

Founded in 1910, the company developed into an international contracting group with headquarters in the Netherlands and the United Kingdom.

Owner of one of the largest and most diversified dredging fleets in the world, Boskalis Westminster has expanded its expertise to include dredging and reclamation, civil and hydraulic engineering; dry earth moving; pipelaying at sea and on land; construction and operation of SPM's; rock drilling and blasting; surface and underground railway engineering; building and construction; consultancy; design; project development and management; site investigation and survey; the manufacture of electronic navigational aids; offshore structure design, maintenance and construction management; and deep sea mining.

**Van Der Kamp Beheer B.V., P.O. Box 146, 800 AC Zwolle**

| | | | |
|---|---|---|---|
| "Hein" | — | 3,000 hp | S |
| "Ijsseldelta" | 1,700 cu. m. | 2,250 hp | TH |

**Van Oord-Utrecht N.V., 1, Oude Haven, P.O. Box 15, 3984 ZG Odijk, Phone: 03405-611 44, Telex: 47566 (oord nl)**

| | | |
|---|---|---|
| "Zeeland" | 30 in. | CS |
| "Noordzee" | 30 in. | CS |
| "Merwede" | 26 in. | CS |
| "Utrecht" | 26 in. | CS |
| "Waddenzee" | 26 in. | CS |
| "Rotterdam" | 26 in. | S |
| "Westerschelde" | 26 in. | S |
| "Vianen" | 26 in. | S |

Van Oord-Utrecht B.V. member of the Van Oord Group of Odijk, The Netherlands, is a contracting company specialized in major earthmoving, highway and hydraulic projects, with a particular emphasis on the disciplines of dredging and the hydraulic reclamation of land.

**Van Oord Werkendam bv, P.O. Box 8, 4250 DA Werkendam** *(See Hollandsche Aanneming Maatschappij bv, The Netherlands).*

**Volker Stevin Dredging B.V., P.O. Box 2695 71 Oostmaaslaan, 3000 CR Rotterdam**

| | | | |
|---|---|---|---|
| "Geopotes X" | 9,074 cu. m. | 19,032 hp | TH |
| "Geopotes IX" | 6,400 cu. m. | 10,801 hp | TH |
| "Geopotes VII" | 4,426 cu. m. | 6,420 hp | TH |
| "Geopotes VI" | 4,221 cu. m. | 7,891 hp | TH |
| "Geopotes 12" | 3,421 cu. m. | 6,470 hp | TH |
| "A.D. Geopotes 1" | 3,157 cu. m. | 7,772 hp | TH |
| "Geopotes 11" | 1,560 cu. m. | 3,527 hp | TH |
| "Sliedrecht 30" | 850 mm | 7,450 hp | CS |
| "Sliedrecht 31" | 850 mm | 7,754 hp | CS |
| "A.D. Australia" | 850 mm | 9,032 hp | CS |
| "Sliedrecht 33" | 850 mm | 10,450 hp | CS |
| "Beverwijk 31" | 800 mm | 11,702 hp | CS |
| "Beverwijk 39" | 800 mm | 9,320 hp | CS |
| "R.T.G. 32" | 750 mm | 3,581 hp | CS |
| "Sliedrecht XVI" | 650 mm | 4,265 hp | CS |
| "Sliedrecht 29" | 650 mm | 4,440 hp | CS |
| "Otter" | 650 mm | 2,326 hp | CS |
| "Beverwijk 38" | 600 mm | 6,081 hp | CS |
| "Beverwijk 51" | 350 mm | 1,041 hp | CS |
| "Sliedrecht 27" | 850 mm | 9,736 hp | S |
| "Sliedrecht XXIV" | 750 mm | 6,717 hp | S |
| "Sliedrecht XXV" | 750 mm | 2,990 hp | S |
| "Sliedrecht 26" | 850 mm | 6,501 hp | SH |
| "Sliedrecht XIV" | 650 mm | 2,160 hp | SH |
| "Sliedrecht XX" | 650 mm | 2,263 hp | SH |
| "R.T.G. 33" | 600 mm | 1,420 hp | SH |
| "R.T.G. 37" | 600 mm | 5,622 hp | SH |
| "Maas" | 1,000 L | 690 hp | BL |
| "Ijsse" | 1,000 L | 516 hp | BL |
| "R.T.G. 1" | 950 L | 1,020 hp | BL |
| "R.T.G. 2" | 950 L | 1,020 hp | BL |
| "Nasr 5" | 850/1,050 L | 1,075 hp | BL |
| "Hippopotes" | — | 823 hp | BD |
| "Lek" | 700 L | 519 hp | BL |
| "Nasr 4" | 600 L | 635 hp | BL |

**WMN. B.V. Aannemingsbedrijf, P.O. Box 32 Papendrecht**

| | | | |
|---|---|---|---|
| "Papendrecht I" | 24 in. | 2,300 hp | CS |
| "Dordrecht" | 24 in. | 2,300 hp | CS |
| "Zwijndrecht" | 20 in. | 1,400 hp | CS |
| "Papendrecht II" | 24 in. | 3,300 hp | S |
| "Wieldrecht" | 20 in. | 2,500 hp | S |
| "Woensdrecht" | 12 in. | 450 hp | S |

WMN was founded in 1961 and specialized in vertical sanddrains. In Holland many roads, dikes and industrial areas are built on clay or peat with very poor stability. The vertical sanddrain is a method of increasing the stability of these soils.

The company has now expanded to engineering works—earth moving, road building and sewer construction, and can complete entire town and industrial developments.

In 1965 a small portable cutter dredge was purchased for highway construction in an inaccessible area of Holland. The company now transports its dredges all over Europe by truck, and will soon begin contracting outside Europe.

Company officials are:
Ing. J. A. Galavazi—president, managing director;
Ing. W. G. van der Wiel—managing director;
Ing. W. G. Hermans—manager, acquisition;
Ing. J. de Jong—manager, calculations;
Ir. J. W. Sip—research and development.

**Zand Exploitatie Maatschappij Reimerswaal B.V., Horscamp 24, 8861 TP Harlingen**

| | | | |
|---|---|---|---|
| "Reimerswaal" | — | 1,040 hp | TH |

**Zanen Verstoep N.V., Surinamestraat 29, P.O. Box 80549, 2508 GH, The Hague, Tel.: 070-607925; Telex: 31254zvhnl**

| | | | |
|---|---|---|---|
| "Hendrik Zanen" | 5,750 cu. m. | 10,740 hp | TH |
| "Rendsburg" | 1,040 cu. m. | 1,450 hp | TH |
| "Cornelis Zanen" | 8,000 cu. m. | 15,025 hp | TH |
| "Barent Zanen" | 8,000 cu. m. | 15,550 hp | TH |
| "Aquarius" | 34 in. | 17,500 hp | CS |
| "Libra" | 34 in. | 17,500 hp | CS |
| "Taurus" | 34 in. | 21,244 hp | CS |
| "'s-Gravenhage" | 825 L | 1,600 hp | BL |
| "Abidjan" | 26 in. | 2,615 hp | CS |
| "Scorpio" | 32 in. | 4,160 hp | BWS |
| "Gemini" | 32 in. | 4,160 hp | BWS |
| "Uruk"* | 28 in. | 4,110 hp | BWS |
| "Larsa"* | 28 in. | 4,110 hp | BWS |
| "Isin"* | 28 in. | 4,110 hp | BWS |
| "Linge" | 20 in. | 1,140 hp | S |
| "Merwede" | 32 in. | 3,450 hp | S |
| "IJssel" | 32 in. | 3,450 hp | S |
| "Le Barcares" | 24 in. | 950 hp | S |
| "Long Reach" | 250 TM | 510 hp | BG |

* jointly owned

Zanen Verstoep, founded in 1850, is an internationally operating dredging company, with contracts worldwide, specializing in harbor and marine works, reclamation of ports and industrial sites. Major contracts have been carried out in Belgium, France, United Kingdom, Ireland, Germany, Spain, Congo, Brazil, Peru, the Middle and Far East, Nigeria, Canada, as well as throughout the Netherlands.

Board of managing directors:
Drs. M.W. Dekker—chairman;
Ing. J. Jonker;
W.A. Luyberhuizen.

Deputy directors:
Ir. J. Franje;
Ir. J.J. Hazelbag;
J.C. Schouten;
Ir. T. van Wijk.

## NETHERLANDS ANTILLES

**Ballast-Trailing N.V., Chumaceirokade 5, Willemstad, Curacao (Subs. Amsterdam Ballast Dredging Co.)**

| | | | |
|---|---|---|---|
| "Humber River" | 12,500 cu. yds. | 16,000 hp | TH |
| "Oranjestad" | 5,500 cu. yds. | 6,120 hp | TH |
| "Willemstad" | 4,200 cu. yds. | 7,200 hp | TH |

*(See Amsterdam Ballast Dredging, Amstelveen, Holland, Div. of Ballast-Nedam Groep N.V.).*

## NEW ZEALAND

**Auckland Harbour Board, C.P.O. Box 1259, Auckland**

| | | | |
|---|---|---|---|
| "Horanui" | 18 in. | 1,270 hp | CS |
| "Kerinui" | 3/4 cu. yd. | 895 hp | BL |
| "Taniwha" | 1/3 cu. yd. | 72 hp | BG |

**Greymouth Harbour Board, P.O. Box 76, Greymouth**

| | | | |
|---|---|---|---|
| "No. 1" | 1 cu. yd. | — | BL |
| "A.C." | 500 tons | — | TH BG |

**Lyttleton Harbour Board, P.O. Box 2108, Christchurch**

| | | | |
|---|---|---|---|
| "Peraki" | 30 in. | 2,500 hp | CS |
| "Te Whaka" | 50 cu. ft. | 300 hp | GH |

**Ministry of Transport, New Zealand Government, Private Bag, Wellington C.I.**

| | | | |
|---|---|---|---|
| "Kawatiri" | 635 cu. m. | 700 kW | TH GH |

**Nelson Harbour Board, P.O. Box 5003, Port Nelson**

| | | | |
|---|---|---|---|
| "Karitea" | 14 in. (350 mm) | 905 hp | CS |
| "Tasman Bay" | 250 tons | 610 hp | BG |

**Northland Harbour Board, Private Bag, Whangerei**

| | | | |
|---|---|---|---|
| "Thomas Mackinnon" | 12 in. | 600 hp | CS |
| "Te Kau" | 10 in. | 250 hp | CS |

**Southland Harbour Board, P.O. Box 1, Bluff**

| | | | |
|---|---|---|---|
| Mataura" | 14 in. 200 cu yds hr. | 1,000 hp | CS |
| "Stonewall Jackson" | 1.5 cu. yds | 83 hp | BG |

**Taranaki Harbour Board, P.O. Box 348, New Plymouth**

| | | | |
|---|---|---|---|
| "Ngamotu" | 18 in | 800 hp | TH BG |
| "Kahery" | — | 688 hp | BB |

Principal officers are:
R.P. Snodgrass—general manager;
P.N. Atkinson—chief engineer;
D.C. Giles—harbor master.

**Timaru Harbour Board, P.O. Box 76, Timaru**

| | | | |
|---|---|---|---|
| "W.H. Orbell" | 700 mm | 2,500 hp | TH |

The Timaru Harbour Board founded in 1876 has since 1977 operated a trailing hopper dredge on a contract basis on work around New Zealand.

The work comprises general harbor maintenance and capital works including the dredging of offshore entrance channels to ports.

Company officials are:
B.W. Tierney—chief engineer;
R. Stracnan—mechanical engineer;
R. Mitchell—dredging superintendent.

**Waipipi Iron Sands Ltd., (Subsidiary of Utah International), P.O. Box 143, Waverley, North Island**

| | | | |
|---|---|---|---|
| "Waipipi No. 1" | 26 in. | 1,350 hp | CS |
| "Waipipi No. 2" | 26 in. | 1,350 hp | CS |

V.S. Wein—general manager;
J.G. Daniell—administrative manager;
M.J. Creek—maintenance & engineering manager;
A.D. Oulaghan—financial controller.

**Wanganui Harbour Board, P.O. Box 8001, Castlecliff, Wanganui**

| | | | |
|---|---|---|---|
| "Wanganui" | 3 cu. yds. | — | G- |

**Wellington Harbour Board, P.O. Box 893, Wellington**

| | | | |
|---|---|---|---|
| "Kerimoana" | — | 240 hp | G- |

## NIGERIA

**HAM Dredging (Nigeria) Limited, P.O. Box 826, Ikeja**

**Westminster Dredging (Nigeria) Ltd., Obafon Yard, Kiri-Kiri, Lagos**

*(See Royal Boskalis Westminster N.V., The Netherlands).*

**Nigerian Ports Authority, 26-28 Marina, Pvt. Mail Bag 12588, Lagos**

| | | | |
|---|---|---|---|
| "Sea Lion" | 3,750 cu. m. | 3,880 hp | TH |

## NORWAY

**A/S Hoyer-Ellefsen, Rolf Olsens vei 26 Oslo 1**

| | | | |
|---|---|---|---|
| "Yankee 5" | 100 cu. yds./hr. | — | BG |
| "Yankee 1" | 75 cu. yds./hr. | — | BG |
| "Miniyankee" | 50 cu. yds./hr. | — | BB |

**Coast Directorate, Dronningenst. 6, P.O. Box 8158, Oslo 1**

| | | | |
|---|---|---|---|
| "Storhavn" | 4½ cu. yds. | 678 hp | BD |
| "Berghavn" | 4 cu. yds. | 700 hp | BD |
| "Oddhavn" | 5 cu. yds. | 230 hp | BG |
| "Godhavn" | 2 cu. yds. | 200 hp | BG |
| "Skjaerhavn" | 2 cu. yds. | 200 hp | BG |
| "Tromshavn" | 2 cu. yds. | 200 hp | BG |
| "Fjordhavn" | 1½ cu. yds. | 130 hp | BG |
| "Newbuilding" | 18 in. | 1,430 hp | GS |

**Grunfeldt Karlsen, Hamreheia 30, 4600 Kristiansand S.**

| | | | |
|---|---|---|---|
| "Sanda" | — | 360 hp | S |

**Hans Norland, 4100 Jorpeland**

| | | | |
|---|---|---|---|
| "Tunstein" | — | 450 hp | — |

**Igenior F. Selmer A/S, P.O. Box 6035, Oslo 1**

| | | | |
|---|---|---|---|
| "Mjolner" | 18 in. | 1,750 hp | CS |
| "Sleipner" | 18 in. | 1,450 hp | CS |
| "Froy" | 13 cu. yds. | 600 hp | BG |
| "Frigg" | 4 cu. yds. | 300 hp | BG |
| "Odin" | 4 cu. yds. | 400 hp | BG |
| "A-56" | 1 cu. yds. | 120 hp | BG |
| "Jutul III" | 6.5 cu. yds. | 800 hp | BB |

**Olav Stensen & Sonner, 8370 Leknes I Lofoten**

| | | | |
|---|---|---|---|
| M/sp "Gerd Stensen" | 16 in. | 600 hp | S/M |
| M/sp "Frida Stensen" | 20 in. | 750 hp | S/M |

## PAKISTAN

**Karachi Electric Supply Corp. Ltd., P.O. Box 7197, Karachi**

| | | | |
|---|---|---|---|
| "No. 1" | 10 in. | — | CS |

**Karachi Port Trust, Berth No. 7, East Wharf, Keamari, Karachi**

| | | | |
|---|---|---|---|
| "Rajhans" | 800 tons | — | TH |
| "Karamat" | 24 in. | — | CS |
| "Izhar" | 1,250 tons/hr. | — | BL |
| "Fateh" | 1,250 tons/hr. | — | BL |
| "Aminuddin" | 1,000 tons | — | BG |

## PANAMA

**Compania de Obras Edilicias Maritimas Portuarias S.A., Ave. Justo Arosemena Y Calle 1 No. 3-80**

| | | | |
|---|---|---|---|
| "Li Nibani" | 31 in. | 7,025 hp | CS |

**Panama Canal Commission, Dredging Division, APO, Miami 34011**

| | | | |
|---|---|---|---|
| "Mindi" | 28 in. | — | CS |
| "Cascadas" | 15 cu. yds. | — | BD |
| "Goliath" | 7½ cu. yds. | — | BC |
| "Rialto M Christensen" | 15 cu. yds. | — | BD |

## PERU

**Empresa Nacional de Puertos, (Enapu-Peru) Callao**

| | | | |
|---|---|---|---|
| "Marinero Riva" | 1,600 cu. m. | 2,500 hp | SH |
| "Oficial de Mar Landa" | 20 in., 800 cu. m. | 2,478 hp | SH CS |

## PHILIPPINES

**Bureau of Public Works, River Dredging Branch, Flood Control & Drainage Div., Manila**

| | | | |
|---|---|---|---|
| "Damayan" | 16 in. | — | CS |
| "Luzon" | 12 in. | — | CS |
| "Visayas" | 12 in. | — | CS |
| "Mindanao" | 12 in. | — | CS |
| "Dredge 10-1" | 10 in. | — | CS |
| "Dredge 10-2" | 10 in. | — | CS |
| "Dredge 8-1" | 8 in. | — | CS |
| "Dredge 8-2" | 8 in. | — | CS |

**C & A Construction Co., Inc. L & S Bldg., 1414 Roxas Blvd., Manila**

| | | | |
|---|---|---|---|
| "Laguna Bay" | 20 in. | — | CS |
| "Manila Bay" | 450 cu. m./hr. | — | BL |
| "No. 28" | 27 in. | 4,500 hp | CS |

Incorporated in 1955, C & A Construction Company is a 100 percent Filipino corporation and primarily engaged in general construction. Projects now under construction involve waterworks systems, bridges, river retaining walls, rock breakwaters and dredging works. Prior contracts consisted of projects of roads, bridges, irrigation, earthwork, ports and harbors, rock bulkheads, dredging and reclamation. Majority of contracts comes from the Philippine Government. C & A Construction is the pioneer dredging company in the Philippines with a dredging fleet and equipment worth $20 million. The company is the major stockholder in CCT Constructors Corporation, a Filipino corporation involved in dredging and reclamation activities.

Management personnel of C & A Construction are:
Vicente G. Cruz—president;
Melecio Arranz, Jr.—vice president & treasurer;
Cayetano Madriguera—secretary;
Regalado C. Villarama—general manager.

**Construction & Development Corporation of the Phillippines, 355 Buendia Ave. Extension, Makati, Metro Manila D-706, (P.O. Box 1963)**

| | | | |
|---|---|---|---|
| "Saranggani Bay" | 34 in. | 9,200 hp | CS |
| "Illana Bay" | 27 in. | 4,000 hp | CS |
| "Canacao" | 10 in. | 300 hp | CS |

Management personnel are:
Rodolfo M. Cuenca—president;
C.E. McDonoygh—senior head vice president, head of Phillippine Construction operations;
C.E. Sanders—vice president, head of equipment management dept.;
Richard J. Caine—senior vice president, head of International construction;
Rafael F. Simpao—senior vice president, head of corporate finance;
Carlito C. Paulino—senior vice president, head of technical management division.

**Golden River Gold Dredging Co., Peracali**

| | | | |
|---|---|---|---|
| "No. 1" | 6 cu. ft. | — | BL M |

**Harbor Dredging and Reclamation Division, Bureau of Public Works, Manila**

| | | | |
|---|---|---|---|
| "SDH-I" | 750 cu. yds. | 2,365 hp | TH |
| "SDH-II" | 1,000 cu. yds. | 3,356 hp | TH |
| "GDH-I" | 500 cu. yds. | 735 hp | BG |
| "SDP-I" | 20 in. | 2,795 hp | CS |
| "SDP-II" | 20 in. | 2,235 hp | CS |
| "SDP-IV" | 14 in. | 916.75 hp | CS |
| "SDP-V" | 14 in. | 916.75 hp | CS |
| "SDP-VI" | 14 in. | 916.75 hp | CS |
| "SDP-VII" | 20 in. | 2,235 hp | CS |
| "BDL-I" | 540 cu. m. hr. | 826 hp | BL |
| "BDD-I" | 3.4 cu. yd. | 512.5 hp | BD |
| "BDD-II" | 3.4 cu. yd. | 512.5 hp | BD |
| "BDD-III" | 3.4 cu. yd. | 512.5 hp | BD |
| "60-TFC" | 10 cu. yds. | 267 hp | *C C |
| "40-TFC" | 5 cu. yds. | 297 hp | *C BC |
| "17-TFC" | 3 cu. yds. | 188 hp | *C BC |

* C—Crane

**Mulmac Industrial Construction Corporation, No. 45 J.B. Miguel Street Bo. Bambang, Pasig, Metro Manila**

| | | | |
|---|---|---|---|
| "Mulmac 1" | 12 in. | 485 hp | S |
| "Mulmac 2" | 12 in. | 450 hp | S |

## POLAND

**Navimor Foreign Trade Enterprise of Poland, Gdansk**

| | | | |
|---|---|---|---|
| "Marian Bukowski" | 1,600 cu. m. | — | TH |

## PORTUGAL

**Administracao-Geral do Porto de Lisboa, Cais do Sodre, 1293 Lisbon Codex**

| | | | |
|---|---|---|---|
| "Santa Apolonia" | 750 liters | 540 hp | BL |
| "Eng. Santos Silva" | 1.5 cu. m. | 550 hp | GH |
| "Eng. Matos" | 1.5 cu. m. | 171 hp | GH |

**Boskalis Westminster Dragagens (Portugal) Lda. Edificio Aviz., Av. Fontes Pereira de Melo 35-14° Lisbon—1**

*(See also Royal Boskalis Westminster N.V., The Netherlands).*

**Direccao-Geral dos Servicios, Hidraulicos Do Ministerio, das Obras Publicas, Praca do Comercio, Lisbon, Estremadura**

| | | | |
|---|---|---|---|
| "Eng. Eduardo De Arantes E Oliveira" | | | SH |

**DRAGAPOR—Dragagens de Portugal, E.P., Av. Miguel Bombarda 80, -5°, 1000 Lisbon**

| | | | |
|---|---|---|---|
| "Arantes e Oliveira" | 650 cu. m. | 2,753 hp | TH |
| "Bellatrix" | 750 cu. m. | 2,475 hp | TH |
| "Gavial" | 18 in. | 1,450 hp | CS |
| "Eng. Duarte Abecasis" | 18 in. | 1,450 hp | CS |
| "Locengue" | 12 in. | 723 hp | CS |
| "Caimao" | 12 in. | 430 hp | CS |
| "Eng. Henrique Schreck" | 0.6 cu. m. | 635 hp | BL |
| "Arganaz" | 300 cu. m. | 1,065 hp | BG |
| "Esquilo" | 300 cu. m. | 1,065 hp | BG |

**Dragagens e Obras Publicas, Ltda., Rua Rosa Araujo 34, 1°, Lisbon**

| | | | |
|---|---|---|---|
| "Marinha" | 23½ | — | S |
| "Tejo" | 450 liters | — | BL |

**Exploracao de Minas E Dragagens LDA (DRAMIN), Rua Marques D'Avila E Bolama 280, Covilha**

| | | | |
|---|---|---|---|
| "Patin" | 7½ cu. ft. | 400 hp | BL |

**J.A.P. da Figueira da Foz, Figueira da Foz**

| | | | |
|---|---|---|---|
| "Numero Dois" | — | — | BG |

**J.A.P. do Norte, Viana do Castelo**

| | | | |
|---|---|---|---|
| "Fortim" | — | — | BG |

**J.A.P. de Sotavento do Algarve, Tavira, Algarve**

| | | | |
|---|---|---|---|
| "Faro" | — | — | BL |
| "Tavira" | — | — | BG |

**J.A.P. de Setubal, Setubal**

| | | | |
|---|---|---|---|
| "Numero Um" | — | — | BL |

## QATAR

**Boskalis Westminster Middle East Ltd., P.O. Box 5457, Doha**

*(See Royal Boskalis Westminster N.V., The Netherlands).*

## ROMANIA

**NAVROM, Bulevardul Dinicu Golescu, Bucharest**

| | | | |
|---|---|---|---|
| "Calatis" | — | 475 hp | BG |
| "Caracal" | — | 578 hp | BG |
| "Constanta" | — | 475 hp | BG |
| "Dunarea" | — | 475 hp | BG |
| Name Unknown | 3,500 cu. m | — | SH |
| Name Unknown | 3,500 cu. m. | — | SH |
| Name Unknown | 3,500 cu. m. | — | SH |
| Name Unknown | 1,600 cu. m. | — | SH |
| Name Unknown | 1,600 cu. m | — | SH |

## SAUDI-ARABIA

**Boskalis Westminster Al Rushaid Ltd., P.O. Box 539, Dhahran Airport**

*(See Royal Boskalis Westminster N.V., The Netherlands).*

## SINGAPORE

**Port of Singapore Authority, PSA Towers 3, Maritime Square, Telok Blangah Road, P.O. Box 300**

| | | | |
|---|---|---|---|
| "Darok" | — | — | BG |

**P.T. Mercu Agung Sakti, Unit 709, 7th Floor Shenton House 3, Shenton Way 1, Tel.: 220 3414**

*(See P.T. Mercu Agung Sakti, Indonesia)*

**Robin Dredging (Pte.) Ltd., 35 Pioneer Road, Jurong, 2262**

| | | | |
|---|---|---|---|
| "Superstar 1" | 30 in. | 18,300 hp | CS |
| "Superstar 2" | 30 in | 18,300 hp | CS |
| "Superstar 3" | 30 in. | 18,300 hp | CS |
| "Superstar 4" | 4,700 cu. yds. | — | TH |
| "Sea Diamond" | 24 in. | 5,000 hp | CS |
| "Parang Laut" | 24 in. | 2,200 hp | CS |
| "Pisau Laut" | 24 in. | 2,200 hp | CS |
| "Buaya Laut" | 24 in. | 2,200 hp | CS |
| "Mr. Vic" | 24 in. | 2,200 hp | CS |
| "Ikan Paus" | 4 cu. yds. | — | BG |

Robin Dredging (PTE) Ltd., has had 10 years of dredging experience in South East Asia and the Middle East, successfully completing many major capital and maintenance projects. Specialist in all aspects of port and channel dredging, land reclamation, pipeline trench excavation and associated marine construction works. Robin Dredging (PTE) Ltd. is an integrated company within the Robin Group.

Company officials are:
Peter Loh—managing director;
Anthony Smith—projects manager;
Douglas W. Ramsay—contracts manager.

**Selco (Singapore) Pte. Ltd., No. 1, Jalan Samulun, Jurong, 2262**

| | | | |
|---|---|---|---|
| "Pluto" | 20 in. | — | CS |
| "Selco L-26" | 4 cu. yds. | — | BG BC |

Selco Singapore offers comprehensive and fully integrated marine services which include marine salvage and towage, tug and barges charter, marine transportation, diving and underwater services, marine heavy lifts, SBM maintenance and overhaul, moorings, submarine pipelines and general marine contracting work.

Company officials are:
E.E. Kahlenberg—chairman/managing director;
M.F. Lindsell—fleet ownership manager;
Capt. D. Hancock—salvage & international towage manager;
D.J. Warner—port operations manager;
Capt. P. Bird—business development manager.

**F. Selmer (S) Pte. Ltd. 170 Upper Bukit Timah Road #15-01 Bukit Timah Shopping Centre 2158**

Company officials are:
Roar J. Sorlie—managing director;
Victor Foo. C.K.—regional marketing manager.

*(See Norway listing for dredges).*

**Straits Engineers Contracting Pte. Ltd., 75, Jalan Benaan Kapal, 1439. (Postal Address: Maxwell Road, P.O. Box 3899, 9058), Tel.: 345-5257, Telex: RS 23644 RS 35206, Cable: "Strel Singapore"**

| | | | |
|---|---|---|---|
| "Eng Tau" | 3 cu. yds. | — | BG BC |
| "Hwee Ann 31" | 3 cu. yds | — | BG BC |
| "Han Sung 1" | 6 cu. yds | — | BG BC |
| "St. Gerald" | 6 cu. yds. | — | BG BC |
| "St. Jean" | 6 cu. yds. | — | BG BC |
| "St. Ives" | 6 cu. yds. | — | BG BC |
| "St. Marc" | 6 cu. yds | — | BG BC |
| "St. Stephen" | 6 cu. yds | — | BG BC |
| "U May" | 6 cu. yds. | — | BG BC |
| "Hima 1" | 6 cu. yds | — | BG BC |
| "STB 1" | 6 cu. yds. | — | BG BC |
| "STB 5" | 6 cu. yds. | — | BG BC |
| "Straits 1101" | 8 cu. yds. | — | BG BC |
| "Superbreaker" | 60,000 ft. lb | Rock Breaker | |
| "Colossus" | 400 tons | Floating Crane | |

| | | | |
|---|---|---|---|
| "Rimau" | 10 in. | — | CS |
| "Susan" | 14 in. | — | CS |

Straits Engineers Contracting Pte. Ltd. was started in 1962 at the time the Republic of Singapore initiated its industralization program. From a modest beginning in civil and marine engineering projects, the company has expanded its activities into allied fields.

Anticipating the opportunities offered by the oil exploration boom, the company has intensified its efforts in plant hire, making available a full range of tugs, launches, hopper barges, cranes, dredges, and salvage equipment, together with improved technology.

Management personnel are:
G.A.D. Keet—managing director;
David Toms—general manager;
Teo Eng Hwee—manager;
Andrew Low—dredge manager;
Douglas Rankine—dredge superintendent.

**Zanen Verstoep N.V., 19-08 Jalan Sultan Centre, 50, Jalan Sultan, Tel.: 295049, Telex: 34191 rs mecury**
*(See Zanen Verstoep N.V., The Netherlands).*

## SOUTH AFRICA

**Marine Diamond Corp., 3rd Floor, Olivetti House, Hertzog Blvd. P.O. Box 2605, Cape Town, 8001**

| | | | |
|---|---|---|---|
| "Spencer Bay" | 450 cu. m. | 1,000 hp | SH |

**South African Transport Services: Private Bag X47, Johannesburg, 2000**

| | | | |
|---|---|---|---|
| "J.F. Craig" | 400 cu. m. | 1,190 kW | GH/SH |
| "L.R. Warren" | 480 cu. m. | 750 kW | GH |
| "Bontebok" | 2,044 cu. m. | 2,283 kW | SH |
| "Ribbok" | 2,222 cu. m. | 3,700 kW | SH/TH |
| "D.E. Paterson" | 2,830 cu. m. | 3,040 kW | SH/TH |
| "R.E. Jones" | 2,830 cu. m. | 3,400 kW | SH/TH |
| "H.R. Moffatt" | 2,830 cu. m. | 2,580 kW | SH/TH |
| "Steenbok" | — | 710 kW | BL |

## SPAIN

**Antonio Astigarraga Mendizabal, Pescaderia 10, Pasajes, San Sebastian**

| | | | |
|---|---|---|---|
| "Ana Juana" | — | 150 hp | — |

**Areilasa, Sestao, Vizcaya**

| | | | |
|---|---|---|---|
| "Pedro Flano" | — | — | S |

**Dragados y Construcciones, S.A., P° Alameda de Osuna 50, Madrid 22**

| | | | |
|---|---|---|---|
| "Virgen del Aguila" | 27 in. | 3,000 hp | CS |
| "Draceli Dos" | 30 in. | 5,155 hp | CS |
| "Nisshin Maru" | 33 in./30 in. | 12,545 hp | CS |
| "Draceli Uno" | 16 in. | 1,100 hp | CS |
| "Dracastor" | 8 in. | 227 hp | CS |
| "Luis Sanchez Guerra" | 3,178 cu. ft. | 1,200 hp | BL |
| "Dracimca Dos" | 2,11 / cu. ft. | 833 hp | BL |
| "Dracpala" | 6 cu. yds. | 1,255 hp | BB/BD/BC |

**Junta de Obras del Puerto y Ria de Bilbao, Bilbao, Vizcaya**

| | | | |
|---|---|---|---|
| "Ibaizabal" | — | — | — |

**Junta del Puerto de Aviles, Aviles, Oviedo**

| | | | |
|---|---|---|---|
| "Fuensanta" | — | 825 hp | SH |

**Obras y Dragados Aldamiz S.A., San Sebastian, Guipuzco**

| | | | |
|---|---|---|---|
| "Draga Aldamiz" | — | — | BG |

**Sociedad Anonima Trabajos Y Obras (SATO), Zurbano 23, 1° Madrid 4**

| | | | |
|---|---|---|---|
| "Sato Carolina" | 30 in. | — | CS |
| "Mariuca" | 6 cu. yds. | — | BC |
| "Alicia" | 30 cu. ft. | — | BL |

**Sociedad Espanola de Dragados S.A., Rosario Pino 18-3°, Madrid 20**
*(See Royal Boskalis Westminster Group N.V., The Netherlands).*

## SRI LANKA

**Ceylon Fishery Harbours Corp., 106, Haverlock Road, Colombo, 6**

| | | | |
|---|---|---|---|
| "Pokirissa" | — | 490 hp | GH |

**Colombo Port Commissioner, Colombo Commission, Colombo**

| | | | |
|---|---|---|---|
| "Diyakawa" | — | 900 hp | TH |

**Government Stores Department, P.O. Box 528, Colombo**

| | | | |
|---|---|---|---|
| "Kakuluwa" | — | — | SH |

## SWEDEN

**Agnar H. Johansson, Stafettgatan 4B, 416 59 Gothenburg**

| | | | |
|---|---|---|---|
| "Jonas" | — | — | SH |

**Karl Arne & Yngve Johansson, 430 82 Donso**

| | | | |
|---|---|---|---|
| "Stena" | — | 300 hp | S |

**Keelung Harbour Bureau, 8, Kiang Shi Street, Kaoshiung**

| | | | |
|---|---|---|---|
| "Tung Hai" | 1,000 cu. m. | 1,750 hp | TH |

**Lundqvist & Soner Muddrings AB, Box 110, 451 16 Uddevalla**

| | | | |
|---|---|---|---|
| "Storklas" | 2,750 L | 150 hp | BG |
| "Storken" | 5,500 L | 750 hp | BB |
| "Rocky" | 11,500 L | 1,340 hp | BB |

**Port of Gothenburg, P.O. Box 2553, S-403 17, Gothenburg**

| | | | |
|---|---|---|---|
| "Torsviken" | 20 in. | 2,000 hp | S |
| "Bottenopp" | 525 liters | 800 hp | BL |
| "Gripen" | 3.27 cu. yds. | 1,074 hp | BG |
| "No. 2" | 1.96 cu. yds. | 240 hp | BG |

**A.B. Skanska Cementguteriet, 211 02 Malmo**

| | | | |
|---|---|---|---|
| "Scylla" | 24 in. | — | CS |
| "SMV 10" | 24 in. | — | CS |
| "SMV 1" | 20 in. | — | CS |
| "SMV 5" | 18 in. | — | CS |
| "SMV 8" | 8 in. | — | CS |
| "SMV 9" | 8 in. | — | CS |
| "Erik Viking" | 32/50 cu. ft. | — | BL |
| "Skane" | 28 cu. ft. | — | BL |
| "Tor Viking" | 28 cu. ft. | — | BL |
| "Gravlingen" | 4,500 liters | — | BG |
| "Gripen" | 3,500 liters | — | BB |

## TAIWAN
## REPUBLIC OF CHINA

**Kaohsiung Harbor Bureau, No. 62 Lin Hai 2nd Rd., Kaosiung Taiwan**

| | | | |
|---|---|---|---|
| "Kao Ching" | 1,600 cu. m. | 2,575 hp | TH |

**Ret-Ser Engineering Agency, 123, Section 2, Chang An East Road Taipei:**

**Branch offices:**

**RSEA International Pte. Ltd., Unit 1-06, First Floor, UIC Building, 5 Shenton Way, Singapore;**

**RSEA (Guam) International, Julale Center, Room 217 Agana, Guam 96910, U.S.A.;**

**RSEA Indonesia Branch Office, Jl. Cempaka Putih, Tengah No. 43, Jakarta, Indonesia;**

**RSEA Jeddah Branch, Halid Bin Walid Road, Jedah, Saudi Arabia;**

**RSEA Jordan Office, P.O. Box 2896 Jebel Amman, Jordan.**

| | | | |
|---|---|---|---|
| "Ta Hsing" | — | 10,715 hp | CS |
| "Ta Hua" | — | 6,600 hp | CS |
| "Ta Hsia" | 28 in | 4,600 hp | CS |
| "Ta Han" | 28 in. | 4,600 hp | CS |
| "Ta Yu" | 24 in. | 3,200 hp | CS |
| "Ta Shun" | 22 in. | 2,200 hp | CS |
| "Ta Yao" | 20 in. | 1,800 hp | CS |
| "Ta Ming" | — | 500 hp | CS |

**Taichung Harbour Bureau, Taichung Harbour, Taichung**

| | | | |
|---|---|---|---|
| "Chung Kang" | 2,400 cu. m. | 4,500 hp | TH |

**Taiwan Land Development Corp., 42, Hsu Chang Street, Taipei**

| | | | |
|---|---|---|---|
| "Kai Fa No. 1" | — | 560 hp | CS |

## THAILAND

**Aokam Tahi Ltd., P.O. Box 42, Bhuket, Southwest Thailand**

| | | | |
|---|---|---|---|
| "No. 3" | 390,000 cu. yds. month | | BL M |

| | | | |
|---|---|---|---|
| "No. 2" | 336,000 cu. yds./month | | BL/M |

**Bangrin Tin Dredging Co. Ltd., P.O. Box 10, NGOW Ranong, West Thailand**

| | | | |
|---|---|---|---|
| "Dredge No. 3" | 200,000 cu. yds./month | 1,240 hp | BL/M |
| "Dredge No. 4" | 250,000 cu. yds./month | 1,550 hp | BL/M |

**Billiton Thailand Limited, 44-46 Montri Road A-Muang, Phuket 83000**

| | | | |
|---|---|---|---|
| "Narai" | 650 mm (25.6 in.) | 5,085 hp | CS/M |

A wholly owned subsidiary of Billiton B.V., the company has operated as dredging contractors to the Offshore Mining Organization of Thailand since February 1977.

Mining of tin-ore, from offshore alluvial deposits, is conducted in a concession off the west coast of Phangnga Province, Southern Thailand, utilizing the cutter dredge "Narai" and supporting vessels "Erawan" and "Mekhala".

Dr. J.R. Lay—managing director;
J.T. O'Brien—general manager;
Dusit Boonyaratana—administration manager;
H. Vlugter—operations manager;
Thepparit Vesurai—deputy operations manager.

**Government Harbour Dept., Talat Noi, Bangkok**

| | | | |
|---|---|---|---|
| "Chaw Tha K4" | 400 cu. m. | 480 hp | TH |
| "Chaw Tha K2" | 380 cu. m. | 480 hp | TH |
| "Chaw Tha K5" | 1,600 cu. m./hr. | 850 hp | CS |
| "Chaw Tha K7" | 1,600 cu. m./hr. | 850 hp | CS |
| "Chaw Tha K3" | 1,500 cu. m./hr. | 747 hp | CS |
| "Chaw Tha K1" | 1,500 cu. m./hr. | 400 hp | CS |

**Italthai Industrial Co., Ltd., 2013 New Petchburi Rd. Bangkok**

| | | | |
|---|---|---|---|
| "Pamela" | 12 in. | — | CS |
| "Gizela" | 18 in. | — | CS |

**Mining & General Management Co., Ltd., P.O. Box 42, Bhuket**

| | | | |
|---|---|---|---|
| "No. 3" | 390,000 cu. yds./month | — | BL/M |
| "No. 2" | 336,000 cu. yds./month | — | BL/M |

**Port Authority of Thailand, Marine Department, Klongtoi, Bangkok**

| | | | |
|---|---|---|---|
| "Sandon 1" | 1,040 cu. m. | 750 hp | TH |
| "Sandon 4" | 2,000 cu. m. | 750 hp | TH |
| "Sandon 5" | 800 cu. m. | 800 hp | TH |
| "Sandon 6" | 2,000 cu. m. | 800 hp | TH |
| "Rua Khut I" | 225 cu. m./hr. | 260 hp | BG/BC |
| "Rua Khut II" | 300 cu. m./hr. | 300 hp | BL |
| "Rua Khut III" | 300 cu. m./hr. | 300 hp | BG/BC |

**Siamese Tin Syndicate Ltd., P.O. Box 10, NGOW, Ranong, West Thailand**

| | | | |
|---|---|---|---|
| — | 220,000 cu. yds./month | 1,080 hp | BL/M |

**Tongkah Harbour Tin Dredging Ltd., P.O. Box 42, Bhuket, South West Thailand**

| | | | |
|---|---|---|---|
| "Sea Dreage" | 300,000 cu. yds./month | — | BL/M |

## TOGO

**Boka Togo S.A.R.L., P.O. Box 9092, Lome**
*(See Royal Boskalis Westminster N.V., The Netherlands).*

## TRINIDAD

**Alstons Engineering Sales and Service Limited, 219-221 Western Main Road, Cocrite**

**Guanaro Sand & Gravel**

| | | | |
|---|---|---|---|
| "Kerry" | 8 in. | — | B |

**Port Authority of Trinidad & Tobago, Wrightson Road, Port of Spain**

| | | | |
|---|---|---|---|
| "Port of Spain II" | 750 cu. m. | 3,740 hp | TH GH |

**Trinidad Contractors Ltd.**

| | | | |
|---|---|---|---|
| "Bill Dalmen" | 16 in. | — | CS |

## TUNESIA

**Societe Internationale de Dragages et de Travaux Hydrauliques PVW s.a., 2 Rue Mahmout, El Ammabi, 1004—El Menzah VI, Tel.: 2161-231468, Telex: 96—40913069—**
*(See PVW International Dredging and Harbor Works, The Netherlands).*

## TURKEY

**Ministry of Public Works, Republic of Turkey, Railroad & Harbour Const. Dept., Ankara**

| | | | |
|---|---|---|---|
| "Devrim" | 800 cu. m. | — | CS |
| "Akdeniz" | 600 cu. m. | — | HS |
| "Kavrar I" | 2¼ cu. yds. | — | BC/BG |
| "Kavrar II" | 2¼ cu. yds. | — | BC/BG |
| "Kavrar III" | 2¼ cu. yds. | — | BC/BG |
| "Haydarpasa I" | 1½ cu. yds. | — | BC/BG |
| "Haydarpasa II" | 1½ cu. yds. | — | BC/BG |
| "Haydarpasa III" | 1½ cu. yds. | — | BC/BG |
| "Seyhan" | 750 L | — | BL |
| "Izmir" | 500 L | — | BL |
| "Bahadir" | 750 L | — | BL |
| "Ulgen" | 500 L | — | BL |
| "Bayindir" | 250 L | — | BL |
| "Basair" | 250 L | — | BL |

## UNITED ARAB EMIRATES

**Boskalis Westminster Middle East Ltd., P.O. Box 4975, Dubai**
*(See Royal Boskalis Westminster N.V., The Netherlands).*

**Boskalis Westminster Middle East Ltd., P.O. Box 4831, Abu Dhabi**
*(See Royal Boskalis Westminster N.V., The Netherlands).*

**Gulf-Cobla (Private) Limited, P.O. Box 5708, Dubai, Tel.: 04-473260, Telex: 45675 gc dub Telecopier: 04-470320**

| | | | |
|---|---|---|---|
| "Deira Bay" | 22 in. | 3,500 hp | CS |
| "Garhoud Bay" | 22 in. | 3,500 hp | CS |
| "Jebel Ali Bay" | 30 in. | 10,400 hp | CS |
| "Jumeira Bay" | 30 in. | 10,400 hp | CS |
| "Maktoum Bay" | 30 in. | 10,400 hp | CS |
| "Zabeel Bay" | 30 in. | 10,400 hp | CS |

Gulf-Cobla's biggest project to date was the dredging of one of the largest man-made harbors in the world, Mina Jebel Ali Port in Dubai, U.A.E. In addition to this harbor many other dredging contracts have been executed by Gulf-Cobla.

## UNITED KINGDOM

**Alan Charles Riggall, Barrow Haven Marina, Ferry Road, Barrow-on-Humber, South Humberside**

| | | | |
|---|---|---|---|
| "Sandchime" | — | 243 hp | BG |

**Allied Irish Investment Bank, 10 Lombard Street, Belfast**

| | | | |
|---|---|---|---|
| "Barmaid" | 130 | 250 hp | GH |

**A.R.C. Marine Limited, Burnley Wharf, Marine Parade, Northam, Southampton, Hampshire, SO1 1JF**

| | | | |
|---|---|---|---|
| "Arco Thames" | 2,000 cu. m. | 4,200 hp | TH |
| "Arco Tyne" | 2,000 cu. m. | 4,200 hp | TH |
| "Arco Severn" | 1,300 cu. m. | 2,900 hp | TH |
| "Arco Scheldt" | 1,300 cu. m. | 2,900 hp | TH |
| "Arco Trent" | 450 cu. m. | 1,250 hp | TH |
| "Arco Test" | 450 cu. m. | 1,250 hp | TH |
| "Arco Taw" | 200 cu. m. | 600 hp | TH |
| "Arco Tamar" | 200 cu. m. | 600 hp | TH |
| "Deepstone" | 4,200 cu. m. | 6,900 hp | TH |
| "Marinestone" | 2,000 cu. m. | 3,300 hp | TH |
| "Nabstone" | 1,300 cu. m. | 3,500 hp | TH |
| "Arco Stour" | 700 cu. m. | 500 hp | CS |

A.R.C. Marine, a subsidiary of Amey Roadstone Corporation, entered the marine-dredged aggregates business in 1961 and has progressively expanded, both organically and by acquisition; the most recent development being the purchase of Westminster Gravels Limited in April 1982 (previously a Boskalis Group Subsidiary).

The Company now operates a fleet of 11 sea-going dredges, one cutter-suction/processing unit, plus 10 lighters and two tugs; with an annual capacity of approximately seven million tons of material won from the seabed. Supplies are made to company-owned wharves and other contracted outlets in the U.K.,

France, Holland and Belgium.

A.R.C. Marine's operations are administered from the Head Ofice at Southampton, backed by branch offices on both the West and East Coasts.

. Amey Roadstone Corporation is part of the Consolidated Gold Fields Group.

Company officials are:

D.S. Cottell—chief executive;
B.A. Wheeler—commercial director;
C.J. Pitts—finance director;
R.J. Pearson—operations director;
B. Jackson—technical director.

**Blyth Harbour Commission, 79, Bridge Street, Blyth, Northd.**

| | | | |
|---|---|---|---|
| "Cresswell" | — | 700 hp | GH |
| "Crofton" | — | 1,904 hp | TH |

**Bomford & Darr Ltd., Binton, Stratford-on-Avon, Warwickshire**

| | | | |
|---|---|---|---|
| "Mark I" | 6 in. | — | CS |
| "Mark II" | 6 in. | — | CS |

**Bridlington Harbour Commissioners, Harbour Road, Bridlington, North Humberside**

| | | | |
|---|---|---|---|
| "Essex Lady" | — | 218 hp | GH |

**British Dredging Aggregates Ltd., Avondale House, Avondale Road, Cardiff, CF1 7XB**

| | | | |
|---|---|---|---|
| "Bowqueen" | 842.6 cu. m. | 1,864 hp | TH |
| "Peterston" | 483.7 cu. m. | 810 hp | TH |
| "Bowcross" | 765.0 cu. m. | 1,000 hp | TH |

**British Dredging (Sand & Gravel) Ltd., 35 Manor Road, Romford, Essex**

| | | | |
|---|---|---|---|
| "Bowherald" | 2,070 cu. m. | 4,600 hp | TH |
| "Bowknight" | 2,079 cu. m. | 4,600 hp | TH |
| "Bowstream" | 1,026 cu. m. | 2,000 hp | TH |
| "Bowprince" | 1,020 cu. m. | 1,864 hp | TH |
| "Bowbelle" | 961 cu. m. | 1,864 hp | TH |
| "Bowsprite" | 934 cu. m. | 1,864 hp | TH |
| "Bowtrader" | 1,171 cu. m. | 2,100 hp | SH |
| "Bowfleet" | 1,000 cu. m. | 1,864 hp | SH |

**British Transport Docks Board, Melbury House, Melbury Terrace, London, NW 6JY, Tel.: 01-486 6621, Telex: 23913**

| | | | |
|---|---|---|---|
| "Swansea Bay" | 3,600 cu. yds. | 4,600 hp | TH |
| "Baglan" | 2,670 cu. yds./hr. | 4,000 hp | TH |
| "Lavernock" | 2,670 cu. yds./hr. | 4,000 hp | TH |
| "Skitter Ness" | 2,400 cu. yds./hr. | 2,044 hp | TH |
| "Clee Ness" | 2,400 cu. yds./hr. | 1,130 hp | TH |
| "Bleasdale" | 1,275 cu. yds./hr. | 1,800 hp | TH |
| "Aberavon" | 1,200 cu. yds./hr. | 3,000 hp | BG |
| "Redcliffe Sand" | 755 cu. yds./hr. | 1,580 hp | BG |
| "Ely" | 720 cu. yds./hr. | 1,570 hp | BG |
| "Trinity Sand" | 720 cu. yds./hr. | 706 hp | BG |
| "Cherry Sand" | 504 cu. yds./hr. | 1,790 hp | BG |
| "Cave Sand" | 504 cu. yds./hr. | 1,790 hp | BG |
| "Rhymney" | 368 cu. yds./hr. | 785 hp | BG |
| "Calatria" | 230 cu. yds./hr. | 1,100 hp | BG |
| "Lenne Regis" | 275 cu. yds./hr. | 1,010 hp | BG |
| "Hebble Sand" | 275 cu. yds./hr. | 1,010 hp | BG |
| "Ogmore" | 240 cu. yds. hr. | 1,100 hp | BG |
| "Goole Bight" | 124 cu. yds./hr. | 480 hp | BG |

**British Waterways Board, Glouchester**

| | | | |
|---|---|---|---|
| "Thomas Fletcher" | — | — | B |

**Bury Sand Co. Ltd., Swansea**

| | | | |
|---|---|---|---|
| "Rhone" | — | 400 hp | — |

**Cattewater Harbour Commissioners, 2, The Barbican, Plymouth**

| | | | |
|---|---|---|---|
| "Plymsand" | — | 420 hp | GH |

**Civil and Marine Ltd., Johnsons Wharf, King Edward Road, Greenithe Kent**

| | | | |
|---|---|---|---|
| "M.V. Cambrook" | 27 in. | 1,980 hp | SH |
| "M.V. Camborne" | 30 in. | 4,250 hp | TH |
| "M.V. Cambrae" | 27 in. | 5,500 hp | TH |

Company officials are:

J.M. Ureh—chairman and managing director;
R.T. Hockliffe—engineering director;
Capt. M.G. Morgan—marine director;
Rear Admiral Sir David Scott—director;
P.J. Andras—director.

**Clyde Port Authority, 16, Robertson Street, Glascow, G2 8DS**

| | | | |
|---|---|---|---|
| "Blythswood" | — | 1,300 hp | B |
| "Lennox II" | — | 1,100 hp | GH |

**D. Cook Ltd., Airport Garage, Hedon Road, Hull**

| | | | |
|---|---|---|---|
| "Burcom Sand" | — | 720 hp | GH |
| "Foremost 50" | — | 400 hp | GH |

**Cortend Ltd., 8, Bath Lane Cottages, Bath Lane, Fareham, Hants., PO 16 ODQ**

| | | | |
|---|---|---|---|
| "Hexhamshire Lass" | — | 845 hp | TH |

**Costain-Blankevoort (U.K.) Dredging Co. Ltd., 111 Westminster Bridge Rd. London SE1 7UE, Tel.: 01-9284977, Telex: 8811804G**

*(See Costain-Blankevoort, Int. Dredging Co. Ltd., The Netherlands).*

**Department of Agriculture & Fisheries for Scotland, Secretary of State for Scotland, Fleet Support Unit, Chesser House, Gorgie Rd., Edinburgh EH113AW**

| | | | |
|---|---|---|---|
| "Shearwater" | — | 360 hp | — |

**Dept. of the Environmft DCES, Maritime Branch, Lunar House, Croydon CR9 2EL**

| | | | |
|---|---|---|---|
| "St. Giles" | 400 cu. yds. | — | BG |
| "St. Martin" | 200 cu. yds. | — | BG |

**District Council of Thanet, Harbour Office, Ramsgate, Kent**

| | | | |
|---|---|---|---|
| "Ramsgate" | 91 cu. m. | 200 hp | GH |

**D.O.S. Dredging Co. Ltd., Alba House, 238 High St., Epping, Essex CM16 4AP**

| | | | |
|---|---|---|---|
| "Pacifique" | 12,000 cu. yds. | — | TH |

**Dover Harbour Board, Harbour House, Dover, Kent**

| | | | |
|---|---|---|---|
| "Admiral Day" | 191 cu. m. | 660 hp | SH |

**Forth Ports Authority, Tower Place, Leith, Edinburgh, EH6 7DB**

| | | | |
|---|---|---|---|
| "Abbotsgrange" | 1,529 cu. m. | 4,024 hp | TH |

**T.W. Grace, 6, Higher Church Street, Barnstaple, Devon**

| | | | |
|---|---|---|---|
| "Ted Grace" | — | 136 hp | SH |

**HAM Dredging Ltd., Regal House, London Road, Twickenham, TW1 3QX**

*(See Hollandsche Aanneming Maatshappij B.V. (HAM)-Netherlands).*

**Harbour Dredging (U.K.) Ltd., 8, Duncombe Place, York**

| | | | |
|---|---|---|---|
| "Hooksand" | — | 298 hp | S |

**E.G. Harris Ltd., The Belfry, Court Rd., Maidenhead, Berkshire**

| | | | |
|---|---|---|---|
| "Mudcat No. 1" | 6 in./8 in. | — | CS |
| "Mudcat No. 2" | 6 in./8 in. | — | CS |
| "Mudcat No. 3" | 6 in./8 in. | — | CS |
| "Mudcat No. 4" | 6 in./8 in. | — | CS |
| "Mudcat No. 5" | 6 in./8 in. | — | CS |
| "Aquacat No. 1" | 1/3 cu. yd. | — | BB |
| "Aquacat No. 2" | 1/2 cu. yd. | — | BB |
| "Aquacat No. 3" | 1/3 cu. yd. | — | BB |
| "Aquacat No. 4" | 1/3 cu. yd. | — | BB |
| "Aquacat No. 5" | 1/3 cu. yd. | — | BB |
| "Aquacat No. 6" | 1/3 cu. yd. | — | BB |
| "Aquacat No. 7" | 1/3 cu. yd. | — | BB |
| "Aquacat No. 8" | 1/3 cu. yd. | — | BB |

Founded in 1974 the Company has built up its reputation for inland dredging by specializing in giving an "all in" service to the consumer.

Company directors are:

E.G. Harris;
J.E. Bingham.

**Hollacombe Aggregates Ltd., 30, Torr Bridge Park, Yealmpton, Plymouth**

| | | | |
|---|---|---|---|
| "Coedmore" | — | 160 hp | — |

**Holland Dredging Co. (U.K.) Ltd., Alresford House West St., Farnham, GU9 7EH, Surrey, Tel.: (0252) 722020, Telex: 858382**

**Hoveringham Group Ltd., Cargo Fleet Wharf, West Ferry Road, London, E14**

| | | | |
|---|---|---|---|
| "Hoveringham I" | — | 890 hp | SH |
| "Hoveringham IV" | 625 cu. m. | 1,050 hp | SH |

| | | | |
|---|---|---|---|
| "Hoveringham V" | 625 cu. m. | 1,050 hp | SH |
| "Hoveringham VI" | — | 1,350 hp | SH |

**Howard Doris Ltd., 17, Grosvenor Gardens, London, SW1W OBD**

| | | | |
|---|---|---|---|
| "Lune Deep" | — | 750 hp | S |

**Humber Work Boats (Barton) Ltd., The Old Signal Station, Stration Road, South Killingholme, Grimsby, South Humberside DN40 3ED**

| | | | |
|---|---|---|---|
| "Breckland" | 268 cu. m. | 830 hp | GH |

**Ipswich Port Authority, Old Custom House, Key Street, Ipswich, 1P4 1BY.**

| | | | |
|---|---|---|---|
| "Samuel Armstrong" | — | 700 hp | GH |

**Isle of Man Harbour, Sea Terminal Building, P.O. Box 11, Isle of Man**

| | | | |
|---|---|---|---|
| "Mannin" | 130 cu. m. | 240 hp | GH |

**Jones & Bailey Contractors Ltd., 8, Duncombe Place, York**

| | | | |
|---|---|---|---|
| "Grassendale" | — | 750 hp | GH |

**Kelman Marine, 7, Bales Building, Argyl Street, Inverness**

| | | | |
|---|---|---|---|
| "Robert Weir" | — | 600 hp | SH |

**Kendall Brothers (Portsmouth), Kendalls Wharf, Eastern Road, Portsmouth PO3 5LY**

| | | | |
|---|---|---|---|
| "Kaibeyar" | — | 595 hp | SH |

**Lancaster Port Commission, Dock Office, West Quay, Glasgow Dock, Lancaster**

| | | | |
|---|---|---|---|
| "Mannin 2" | — | 240 hp | BG |

**Lincoln & Hull Marine, 88, Lime Street, Hull, HU8 7AR**

| | | | |
|---|---|---|---|
| "Jean Ingelow" | 85 cu. m. | 204 hp | GH |

**Littlehampton Harbour Board, 1, Arundel Road, Littlehampton, West Sussex**

| | | | |
|---|---|---|---|
| "George Campbell" | — | 420 hp | — |

**Macdredge Division of J.T. Mackley & Co. Ltd., Bankside House, Henfield Road, Small Dole Henfield Sussex, BN 5 9XQ**

| | | | |
|---|---|---|---|
| "Mudpiper" | 12 in. | 480 hp | CS |
| "Walrus" | 8 in. | 365 hp | CS |
| "Mudsucker" | 8 in. | 200 hp | S |
| "Pontoon Grabs" | 1 ¼ cu. yd. to 2 cu. yds. | — | BC/BG |

**Malcolm Carrington & Stephen Charles Smart, 26, Arcadia Road, Instead Rise, Northfleet**

| | | | |
|---|---|---|---|
| "Black Gem" | — | 375 hp | SH |

**Marcon R.M.C. Ltd., 4, Highbury Crescent, Highbury Corner, London**

| | | | |
|---|---|---|---|
| "El Flamingo" | — | 2,500 hp | SH |

**Medway Secondary Metals Ltd., Boors Wharf, Lower Rainham Road, Rainham, Gillingham, Kent**

| | | | |
|---|---|---|---|
| "Medway SM 1" | — | 212 hp | BG |

**Mersey Docks and Harbour Co., Port of Liverpool Building Pier Head, Liverpool L31BZ**

| | | | |
|---|---|---|---|
| "Mersey Venture" | 800 mm | 6,000 hp | TH |
| "Mersey Mariner" | 1,900 cu. m. | 4,000 hp | GH |

J.B. Fitzpatrick C.B.E.—managing director;
M. Anderson—financial director;
T. Furlong—port services director;
Capt. K.J. Lewis—marine operations manager;
Capt. B.G. McShane—hydrographic officer.

**Milford Docks Co., The Docks, Milford Haven, Dyfed**

| | | | |
|---|---|---|---|
| "Lake Lothing" | — | 720 hp | GH |

**Newport Marine Aggregates Ltd., 40, Carrisbrooke Road, Newport, Isle of Wight**

| | | | |
|---|---|---|---|
| "Nigel" | — | — | SH |

**Northwood (Fareham) Ltd., 8, Bath Lane Cottages, Bath Lane, Fareham, Hants**

| | | | |
|---|---|---|---|
| "Afan" | — | 1,840 hp | TH |
| "Steel Welder" | — | 570 hp | TH |

**Parkroy Transport Ltd., Mainsforth Terrace, Hartlepool, Cleveland**

| | | | |
|---|---|---|---|
| "Dianne K" | 18 in. | 375 p | S |

**Poole Harbour Commissioners, Harbour Office, Poole, Dorset**

| | | | |
|---|---|---|---|
| "C.H. Horn" | — | 165 hp | SH |

**Port of London Authority, Directorate of Marine Services, Thames House, Gallions Entrance, London E.16**

| | | | |
|---|---|---|---|
| "P.L.A. Albert" | 120 cu. ft. | — | BG |
| "P.L.A. Victoria" | 120 cu. ft. | — | BG |
| "P.L.A. George" | 120 cu. ft. | — | BG |

**Port of Sunderland Authority, Barrack Street, Sunderland, SR1 2EU**

| | | | |
|---|---|---|---|
| "Vedra" | — | — | BG |

**Port of Tyne Authority, Bewick Street, Newcastle upon Tyne, NE 1 5HS**

| | | | |
|---|---|---|---|
| "Hedwin" | 590 cu. m. | 1,260 hp | GH |

**Pounds Marine Shipping Ltd., Beechlands, 49, Bedhampton Hill, Bedhampton, Havant, Hants, PO9 3HJ**

| | | | |
|---|---|---|---|
| "Sea Skerry" | — | 500 hp | SH |

**PVW International Dredging and Harbour Works Ltd., 49 Kingsway, P.O. Box 10, Dovercourt, Essex CO12 3JT, Phone 2555-3642/6518, Telex: 987330**

*(See PVW International Dredging and Harbor Works, The Netherlands).*

**Redland Purle Ltd., Claydons Lane, Rayleigh, Essex SS6 7UW**

| | | | |
|---|---|---|---|
| "Humber Lee" | 545 cu. m. | 4,230 hp | SH |

**Sand Supplies (Western) Ltd., Roundway House, 115-119 Newfoundland Road, Bristol, BS2 9LU**

| | | | |
|---|---|---|---|
| "Sand Sapphire" | — | 980 hp | SH |

**The Scarborough Borough Council, St. Nicholas St., Scarborough, North Yorkshire YO11 2HG**

| | | | |
|---|---|---|---|
| "Esk" | 0.765 cu. m. | 240 hp | GH |
| "Skarthi" | 1.4 cu. m. | 230 hp | GH |

The Scarborough Borough Council is a District Council responsible as harbor authority for the ports of Scarborough and Whitby. The dredges "Skarthi" and "Esk" are operated by the Council on maintenance dredging at Scarborough and Whitby harbors, respectively. The "Skarthi" is also made available for hire.

Company officials are:
R. Bradley, Solicitor—cnief executive;
D.G. Bridge, Solicitor—director of administration;
Capt. A.J. Miller—Scarborough harbor master;
Capt. G. Cook—Whitby harbor master.

**Scott (Toomebridge) Ltd., Sand Office, Toomebridge, Antrim**

| | | | |
|---|---|---|---|
| "Coney Island" | — | — | TH |

**Sealink U.K. Ltd., Eversholt House, 163-203, Eversholt Street, London NW1 1BG**

| | | | |
|---|---|---|---|
| "Landguard" | — | 520 hp | GH |

**Seven Seas Dredging Ltd., Marine House, 18 Baker Street, Weybridge, Surrey KT 13 8AU**

*(U.K. Subsidiary of Dredging International N.V.—for details of plant fleet see Dredging International, N.V., Belgium).*

**Solent Aggregates Ltd., 47 Portswood Road, Portswood, Southampton**

| | | | |
|---|---|---|---|
| "Solent Lee" | 525 cu. m. | 875 hp | SH |

**Sondora Shipping Co. S.A., 35, Willoughby Road, London, N8**

| | | | |
|---|---|---|---|
| "Edip" | 500 cu. m. | 725 hp | SH |

**South Coast Shipping Co. Ltd., Canute Chambers, Canute Rd., Southampton SO1 1AB**

| | | | |
|---|---|---|---|
| "Sand Lark" | 12 in. | 834 hp | TH |
| "Sand Tern" | 12 in. | 878 hp | TH |
| "Sand Gull" | 14 in. | 878 hp | TH |
| "Sand Swift" | 21 in. | 1,613 hp | SH |
| "Sand Swan" | 21 in. | 1,613 hp | SH |
| "Sand Serin" | 21 in. | 1,724 hp | TH |
| "Sand Wader" | 33 in. | 6,066 hp | TH |
| "Sand Weaver" | 33 in. | 5,320 hp | TH |

South Coast Shipping is one of the leading companies supplying marine aggregates to the construction industry in Britain and Europe.

The Company was formed in 1946 and at that time its main area of operation was Southampton, where it still has its headquarters.

The company has built up a fleet of modern, sophisticated ships specially designed to trade anywhere in U.K. coastal waters and on the adjacent coast of Europe.

The company is a wholly owned subsidiary of the

Ready Mixed Concrete group.
J.E. Gwilliam—general manager;
G.E. Greenwood—technical manager;
A. Sheppard—accounts manager;
J.L. Stokes—operations manager.

**Southward Marine Aggregates Ltd., 4, Market Hill, Saffron Walden, Essex**

| | | | |
|---|---|---|---|
| "Careyna" | 10 in. | — | TH |

**Tarmac Sand & Gravel Ltd., Shopwyke Road, Chichester, West Sussex**

| | | | |
|---|---|---|---|
| "Chichester City" | — | 1,000 hp | S |
| "Chichester Star" | 784 cu. m. | 1,250 hp | SH |

**Tees and Hartlepool Port Authority, Middlesborough**

| | | | |
|---|---|---|---|
| "Heartnesse" | 1,500 cu. m. | — | TH |
| "Cleveland County" | 1,500 cu. m. | — | TH |
| "Seal Sands" | 576 cu. m. | — | GH |

**UML Ltd., Wood Street, Ports Sunlight, Wirral Merseyside L62 4XN**

| | | | |
|---|---|---|---|
| "Sand Swallow III" | 85 cu. ft. | 1,100 hp | GH |

UML Limited is a Unilever services company which offers dock and port estate services on the Wirral bank of the River Mersey and spare dredging capacity to other users in the U.K.

Company officials are:
J.M.B. Duckworth—managing director;
D.H.C. McAuslan—technical & services director;
C. Coward—traffic manager;
Capt. H. Grant—dock manager & dockmaster;
J.A. Parsons—traffic marketing manager.

**Westminster Dredging Company Ltd., 8 Suffolk Street, London SW1Y 4HG**
*(See Royal Boskalis Westminster N.V., The Netherlands).*

**Westminster Dredging Company Ltd., Westminster House, P.O. Box 7, Blacknest, Alton, Hampshire GU34 4PU**
*(See Royal Boskalis Westminster Group N.V., The Netherlands).*

**Westminster Dredging Company, Ltd., James Wharf, Belvidere Road, Northam, Southampton, SO9 7AG**
*(See Royal Boskalis Westminster Group N.V., The Netherlands).*

**Rock Fall Company Ltd., James Wharf, Belvidere Road, Northam, Southampton SO9 7AG.**
*(See Royal Boskalis Westminster N.V., The Netherlands).*

**Whitehaven Harbour Commissioners, Harbour Office, Whitehaven, Cumbria**

| | | | |
|---|---|---|---|
| "Clearway" | — | 300 hp | GH |

**Zanen Dredging and Contracting Co. Ltd., Zanen House, 11, King's Road West, Newbury/Berkshire RG 14 5RA, Tel.: (0635)48220; Telex: 848539 zanen g**
*(See Zanen Verstoep N.V., The Netherlands).*

## URUGUAY

**Administracion Nacional de Puertos, 25 De Agosto De 1825, No. 160, Montevideo**

| | | | |
|---|---|---|---|
| "Draga D-7" | 3,250 cu. yds. | — | TH |
| "D-6" | 1/2 cu. m. | — | BL |
| "D-8" | 450 mm | — | CS |

**M.T.O.P. Direccion de Hidrografia, Casilla de Correo N° 413, Montevideo (R.O.U.)**

## U.S.S.R.

**Sudoimport, Moscow**

| | | | |
|---|---|---|---|
| "Gogland" | 6,000 cu. m. | — | TH |
| "CO 831" | 2,920 cu. m. | 5,590 hp | SH |
| "Jasienski" | 1,180 cu. m. | 3,310 hp | SH |
| "Naruski" | 1,180 cu. m. | 3,310 hp | SH |
| "Uyborgski" | 1,180 cu. m. | 3,310 hp | SH |
| "Ivan Babuskin" | 630 cu. m. | 1,310 hp | SH |
| "Iana" | 600 cu. m. | 1,730 hp | SH |
| "Urengoj" | 600 cu. m. | 1,730 hp | SH |

**USSR Ministry of Merchant Marine, 1/4 Zhdanova Street, Moscow, U.S.S.R. 103759. Cable: Morflot Moscow; Telex: 7197; Tel.: 226-10-00**

| | | | |
|---|---|---|---|
| "Azovskoe More" | 2,500 cu. m. | 5,650 hp | TH/SH |
| "Chyornoe More" | 2,800 cu. m. | 8,500 hp | TH |
| "Narvskiy" | 1,000 cu. m. | 3,400 hp | TH |
| "Khersones" | 3,500 cu. m. | 8,750 hp | TH |
| "Sovetskiy Azerbaydzhan" | 1,200 cu. m./hr. | 3,800 hp | CS |
| "Turayda" | 750 cu. m./hr. | 2,000 hp | BL |
| "Neva" | 400 cu. m./hr. | 1,290 hp | BL |
| "Aleksandr Uvarov" | 750 cu. m./hr. | 3,650 hp | BL |
| "Inzhener Agashin" | 400 cu. m./hr. | 2,450 hp | BL |
| "Araks" | 150 cu. m./hr. | 1,350 hp | GH |
| "Chernomorskaya" | 500 cu. m. | 800 hp | HB |

**U.S.S.R., ul. Smolenskaja Ploschadj 32-34, Moscow-Central**

| | | | |
|---|---|---|---|
| "Aluyev" | — | 2,310 hp | BG |
| "Arabatskiy" | 1,183 cu. m. | 3,000 hp | TH |
| "Baltiyskaya" | — | 1,700 hp | BG |
| "Baltiskoye More" | 3,500 cu. m. | 11,160 hp | TH |
| "Desna" | — | 2,310 hp | BG |
| "Dnestrovskiy Liman" | 1,000 cu. m. | 3,000 hp | TH |
| "Dunay" | — | 2,640 hp | BG |
| "Georgiy Nalivayko" | — | 2,640 hp | BG |
| "Ilyichyovsk" | — | 1,700 hp | BG |
| "Irbenskiy" | 1,000 cu. m. | 2,940 hp | BG |
| "Ivan Babhushkin" | 630 cu. m. | 1,200 hp | TH |
| "Kamchatskiy" | 1,005 cu. m. | 3,600 hp | TH |
| "Kinburnskiy" | 1,000 cu. m. | 3,600 hp | TH |
| "Ladogskaya" | — | 2,640 hp | BG |
| "Ochkov" | — | 1,700 hp | BG |
| "Onegskiy" | 1,183 cu. m. | 3,000 hp | TH |
| "Podvodnik I" | — | — | — |
| "Primorye" | 1,000 cu. m. | 1,470 hp | BG |
| "Rion" | — | 2,640 hp | BG |
| "Severnaya" | — | 2,310 hp | BG |
| "Severodvinskiy" | 1,183 cu. m. | 3,000 hp | TH |
| "Skadovsk" | — | 1,528 hp | BG |
| "Tikhookeanskaya" | — | 1,700 hp | BG |

## VENEZUELA

**Instituto Nacional de Canalizaciones, Calle Caracas, C.C. Tamanaco, Edo Miranda, 61959 Chacao**

| | | | |
|---|---|---|---|
| "Rio Orinoco" | 35 in. | 6,800 hp | TH |
| "Icoa" | 32 in. | 13,680 hp | TH |
| "Catatumbo" | 36 in. | 3,000 hp | TH |
| "Carabobo" | 30 in. | 3,600 hp | CS |
| "Castillete" | 28 in. | 2,700 hp | CS |
| "Borburata" | 28 in. | 2,700 hp | CS |
| "Chiquinquira" | 26 in. | 2,500 hp | CS |
| "Santa Lucia" | 24 in. | 1,726 hp | CS |
| "Esequibo" | 20 in. | 1,700 hp | CS |
| "Punta Brava" | 20 in. | 1,400 hp | CS |
| "Berrio" | 16 in. | 850 hp | CS |

**CVG Ferrominera Orinoco C.A. Puerto Ordaz, Estado Bolivar**

| | | | |
|---|---|---|---|
| "ICOA" | 2,350 cu. m. | — | TH |

## VIETNAM

**Government of the Socialist Republic of Vietnam, Vo Thi Sau 13, Haiphong**

| | | | |
|---|---|---|---|
| "Long Chau" | — | 2,481 hp | TH |
| "Tau Hut 8" | 800 cu. m. | 1,160 hp | TH |

## WEST INDIES

**Corrosion Protections Manufacturing Ltd., 97a Circular Road, San Fernando, Trinidad**

| | | | |
|---|---|---|---|
| "G. I. W. No. 1" | 12" | | CS |

**Tugs & Lighters Ltd., P.O. Box 600, 69 Independence Square, Port-of-Spain, Trinidad.**

**Guanapo Sand & Gravel**

| | | | |
|---|---|---|---|
| "Kerry" | 8" | | S |

**Texaco Trinidad Inc.**

| | | | |
|---|---|---|---|
| "Texaco Digger" | 1/4 cu. yd. | | S |

**Trinidad Contractors Ltd.**

| | | | |
|---|---|---|---|
| "Bill Dalmen" | 16" | | CS |
| "2.101.001.01.000" | 12" | | CS |

## YEMEN ARAB REPUBLIC

**Boskalis Westminster Middle East Ltd., P.O Box 2561, Sana'a**
*(See Royal Boskalis Westminster, N.V., The Netherlands)*

# YUGOSLAVIA

**Bagersko brodarska plovidba "Beograd", Hajduk Veljkov Venac 4-6, Belgrad**

| | | | |
|---|---|---|---|
| "Kolubara" 1 | 24" | 2,000 hp | TH |
| "Pliva" | 10" | 250 hp | TH |
| "Sava" | 14" | 500 hp | TH |
| "Drina" | 450 cu.yd./hr. | 450 hp | B |
| "Bistrica" | 300 cu.yd./hr. | 300 hp | B |
| "Bojana" | 300 cu.yd./hr. | 300 hp | B |
| "Moscanica" | 450 cu.yd./hr. | 450 hp | B |
| "Sitnica" | 300 cu.yd./hr. | 300 hp | B |
| "Vardar" | 300 cu.yd./hr. | 300 hp | B |

**"Heroj Pinki", Pristanisna Zona BB, 21000 Novi Sad**

| | | | |
|---|---|---|---|
| "Krka" | 21" | 3,500 hp | SH |
| "Plitvice" | 21" | 1,290 hp | SH |
| "Tisa" | 21" | 1,080 hp | SH |
| "Ludos" | 12" | 430 hp | SH |
| "Vukovar" | 12" | 430 hp | SH |
| "Palic" | 21" | 1,810 hp | CS |
| "Baosic" | 18" | 700 hp | CS |
| "Begej" | 600 cu.m | 1,250 hp | BL |
| "Jecricka" | | 270 hp | BG/BC |

This company deals with water utilization systems, land reclamation, building of riverbeds, lakebeds, piers, winter ports and other water utilization systems, protection walls, and maintaining of waterways

**Hidrosistem Dunav-Tisa-Dunav, Pogon Kanal, Novi Sad**

| | | |
|---|---|---|
| "Kolubara I" | 24" | TH |
| "Piva" | 10" | TH |
| "Drava" | 14" | CS |
| "Medjes" | 90 cu.m./hr | — |
| "Vuka" | 90 cu.m./hr | — |
| "Karas" | 65 cu.m./hr | — |
| "Cik" | 65 cu.m./hr | — |
| "Kiris" | 65 cu.m./hr | — |
| "Studba" | 65 cu.m./hr | — |
| "Sibnica" | 65 cu.m./hr | — |
| "Vizelija" | 65 cu.m./hr | — |
| "Mesic" | 65 cu.m./hr | — |
| "Crna Bara" | 65 cu.m./hr | — |
| "Besni Fok" | 65 cu.m./hr | — |
| "Kalovita" | 65 cu.m./hr | — |

**"Ivan Milutinovic"—PIM, Enterprise for Waterways, Gavrila Principa 22a, Belgrade**

| | | |
|---|---|---|
| "Dunav" | 10" | TH |
| "Lim" | 32" | CS |
| "Stig" | 32" | CS |
| "Sindjelic" | 29-1/2 | CS |
| "Vlasina" | 24" | CS |
| "Piva" | 20" | CS |
| "Strumica" | 20" | CS |
| "Tara" | 20" | CS |
| "Timok" | 20" | CS |
| "Bosut" | 10" | CS |
| "Lab" | 10" | CS |
| "Macva" | 32" | S |
| "Drim" | 26" | S |
| "Zeta" | 26" | S |
| "Dunavac" | 20" | S |
| "Rasina" | 20" | S |
| "Raska" | 20" | S |
| "Topcidarska Reka" | 20" | S |
| "Una" | 300 L | B |

# The United States of America

## ALABAMA

**Aliceville Sand & Gravel Co., Aliceville, 35442**

| | | | |
|---|---|---|---|
| "No. 2" | 10 in. | — | CS/M |
| "No. 1" | 12 in. | — | S/M |
| "No. 3" | 12 in. | — | S/M |
| "No. 4" | 10 in. | — | S/M |
| "No. 5" | 10 in. | — | S/M |
| "No. 6" | 10 in. | — | S/M |

**Bender Welding & Machine Co., Inc. P.O. Box 42, Mobile, 36601**

| | | | |
|---|---|---|---|
| "Dredge Mobile" | 16 in. | — | CS |
| "Mary B" | 10 in. | — | CS |

**Radcliff Materials, Inc., Box 2068, Mobile, 36652**

| | | | |
|---|---|---|---|
| "Gull" | 22 in. | 1,500 hp | CS/M |
| "Pelican" | 20 in. | 1,400 hp | CS/M |
| "Mallard" | 18 in. | 1,200 hp | CS/M |
| "Albatross" | 16 in. | 1,000 hp | CS/M |
| "Flamingo" | 16 in. | 500 hp | CS/M |
| "Shearwater" | 12 in. | 300 hp | CS/M |
| "Sheldrake" | 2-16 in. | 500 hp | S/M |
| "Avocet" | 3-16 in. | 500 hp | S/M |
| "Mr. Norman" | 12 in. | 500 hp | S/M |
| "Pierre" | 8 in. | 240 hp | S/M |

## ALASKA

**Alaska Gold Co., P.O. Box 640, Nome, 99772**

| | | | |
|---|---|---|---|
| "No. 5" | 9 cu. ft. | 1,200 hp | BL/M |
| "No. 6" | 9 cu. ft. | 1,200 hp | BL/M |

**Chris Berg, Inc., 1748 Post Road, Anchorage, 99501, Tel.: (907) 272-3531**

*(See Washington listing).*

**Goodnews Platinum Mining Co., Platinum, 99651**

| | | | |
|---|---|---|---|
| "Yuba" | 8 cu. ft. | — | BL/M |

**Northland Gold Dredging J.V., Nyac, 99642**

| | | | |
|---|---|---|---|
| "Nyac No. 3" | 6 cu. ft. | — | BL/M |

**Phoenix Dredging, P.O. Box 1186, Anchorage, 99510**

| | | | |
|---|---|---|---|
| "Palo Verde" | 10 in. | 500 hp | CS |

**Tuluksak Dredging, Ltd., Nyac, 99642**

| | | | |
|---|---|---|---|
| "Nyac No. 4" | 4½ cu. ft. | — | BL/M |

Management personnel are:
Charles J. Awe, Jr.—president;
Andrea I. Awe—secretary/treasurer.

## ARKANSAS

**Arkansas Valley Dredging Co., Inc., P.O. Box 548, Benton, 72015**

| | | | |
|---|---|---|---|
| "Tulsa" | 24 in. | 2,300 hp | CS |
| "Little Rock" | 18 in. | 1,325 hp | CS |
| "Dredge No. 11" | 18 in. | 1,325 hp | CS |

**Arkhola Sand & Gravel Co., 321 Merchants Bk. Bldg., Ft. Smith, 72901**

| | | | |
|---|---|---|---|
| "Walter S. Dills" | 14 in. | 1,650 hp | CS/M |

**W.D. Jeffrey Construction Co., Box 998, Ft. Smith, 72901**

| | | | |
|---|---|---|---|
| "Rosie Lee 14" | 14 in. | — | CS/M |
| "Cook's Wonder" | 12 in. | — | CS/M |

**Mid-South Dredging Co., Box 4070, Fort Smith, 72914**

| | | | |
|---|---|---|---|
| "Gopher" | 18 in. | 2,000 hp | CS |
| "Andy" | 18 in. | 1,600 hp | CS |

**Pine Bluff Sand & Gravel Co., P.O. Box 7008, Pine Bluff, 71611**

| | | | |
|---|---|---|---|
| "Marion" | 24 in. | 3,710 hp | CS |
| "Butcher" | 24 in. | 2,200 hp | CS/M |
| "Sand Hog" | 10 in. | 365 hp | S/M |

## CALIFORNIA

**Guy F. Atkinson Co., Box 259, Long Beach, 90801**

| | | | |
|---|---|---|---|
| "Mr. Guy" | 10 cu. yds. | — | BC |
| "4410" | 5 cu. yds. | — | BC |
| "44304" | 4 cu. yds. | — | BC |

**California Dredging Co., 1725 Marina Vista, Martinez, 94553**

| | | | |
|---|---|---|---|
| "Sandpiper" | 24 in./1,000 cu. yds. | 1,500 hp | TH |
| "Bobbie J" | 18 in. | 2,750 hp | CS |
| "Mara" | 12 in. | — | CS |
| "Daffy Duck" | 8 in. | — | S |

California Dredging Co. does governmental and industrial contracting, emphasizing jobs that require portable dredges. Olin C. Jones, president.

**Cressey Sand & Gravel, Inc., 3495 No. Snelling Hwy., Merced, 95340**

| | | | |
|---|---|---|---|
| "No. 1" | 6 in. | — | CS/M |

**Dutra Dredging Co., P.O. Box 794, Rio Vista, 94571**

| | | | |
|---|---|---|---|
| "Liberty" | 3 yds. | — | BC |
| "Sacramento" | 3½ +4 yds. | — | BC |
| "Alameda" | 1¾ yds. | — | BC |

**Healy Tibbitts Construction Co., 411 Brannan St., San Francisco, 94107**

| | | | |
|---|---|---|---|
| "No. 42" | 8 cu. yds. | — | BC/BG |
| "No. 3" | 5 cu. yds. | — | BC/BG |
| "Martinez" | 4 cu. yds. | — | BC/BG |
| "No. 43" | 4 cu. yds. | — | BC/BG |
| "No. 40" | 8 cu. yds. | — | BC/BG |

West Coast based, but worldwide in operation, Healy Tibbitts has been in operation since 1886. Work undertaken is all marine-oriented, wharves, piers, submarine pipelines, breakwaters, dredging, to mention major items. Present work is located on East and West Coasts of U.S., Puerto Rico, Philippines, Bombay, Pacific Islands.

Company officials are:
R.H. Smith—president;
J.F. Seery—vice president;
P.J. Robinson—vice president;
V. Dinkler—So. California manager;
A. Rodriguez—No. California manager.

**Hydraulic Dredging, Inc., 782 Ventura St., Richmond, 94805**

| | | | |
|---|---|---|---|
| "Ten Pumper" | 10 in. | — | CS |
| "Pond Pumper" | 8 in. | — | CS |
| "Little Pumper" | 4 in. | — | S |
| "Haviside 4" | 2 cu. yds. | — | BC |
| "Little Clammer" | 1 cu. yd. | — | BC |

The firm specializes in harbor and industrial maintenance.

R.T. Finnegan—vice president & general manager

**Illman Jones Inc, 5733 San Leandro Street, Oakland, 94621.**

| | | | |
|---|---|---|---|
| "Digger I" | | | GH |

**Kiewit Pacific Co., P.O. Box 3128, 505 Santa Clara Street, Vallejo, 94590**

| | | | |
|---|---|---|---|
| "Thelma" | 15 cu. yds. | — | BC |

**San Francisco Port Commission, Ferry Bldg., San Francisco, 94111**

| | | | |
|---|---|---|---|
| "No. 4" | 4 cu. yds. | 250 hp | BC |

**Shellmaker, Inc., 250 Sears Pt. Rd., Petaluma, 94952**

| | | | |
|---|---|---|---|
| "Headway" | 16 in. | 3,000 hp | CS |
| "Beaver" | 16 in. | 2,500 hp | CS |
| "Vanguard" | 16 in. | 2,200 hp | CS |
| "Vagabond" | 16 in. | 2,200 hp | CS |
| "Dana" | 16 in. | 1,200 hp | CS |
| "Traveler" | 8 in. | 300 hp | CS |
| "Digger" | 6 in. | 150 hp | S |

**Smith-Rice Co., 2199 Clement Ave., Alameda, 94501**

| | | | |
|---|---|---|---|
| "Super Scoop" | 14-20 cu. yds. | 1,700 hp | BC/BG |
| "No. 24" | 6-9 cu. yds. | 650 hp | BC/BG |

Management personnel are:
E.R. "Bud" Rice—president, general manager;
W.H. Mueser—vice president, dredging & const.;
Arnold Malley—construction superintendent;
John S. Dieu—construction superintendent.

**U.S. Bureau of Reclamation, Lower Colorado River Project Office, Box 428, Needles, 92363**

| | | | |
|---|---|---|---|
| "Little Colorado" | 12 in. | 900 hp | CS |
| "Gila" | 12 in. | 750 hp | CS |
| "Dredge" | 10 in. | 300 hp | CS |

**Yuba Placer Gold Company, 7545 Hammonton, Star Route, Marysville, 95901**

| | | | |
|---|---|---|---|
| "No. 21 | 14 cu. ft. | — | BL/M |
| "No. 17" | 18 cu. ft. (not operating) | — | BL/M |

A joint venture between Placer Service Inc., a wholly-owned subsidiary of St. Joe Minerals Corporation and Yuba Goldfields, Inc.

Management personnel are:
Jeffrey L. Zelms—president of Placer Service Corp. & general manager, Yuba Placer Gold Co.;
Richard T. Silberman—chairman of the board—Yuba Natural Resources.

## COLORADO

**Builders Aggregate Co., 915 Beaver Ave., Fort Morgan, 80701**

| | | | |
|---|---|---|---|
| "No. 1" | 8 in. | 260 hp | S/M |

**Dye Construction, No. 4 Midland Rd., Colorado Springs, 80906**

| | | | |
|---|---|---|---|
| "No. 2" | 8 in. | 350 hp | CS/M |

**Mobile Premix Concrete, Inc., Box 5183 T.A., Denver, 80217**

| | | | |
|---|---|---|---|
| "No. 1" | 12 in. | 600 hp | CS/M |

## CONNECTICUT

**Essex Island Dock & Dredge, Inc., Ft. of Sunrise Ave., Old Saybrook, 06475**

| | | | |
|---|---|---|---|
| "Mallard I" | 10 in. | — | CS |

**J.L. Spangle Marine Const uction Co., Inc., 28 West Rocks Road, Norwalk, 06851**

| | | | |
|---|---|---|---|
| "Lynn" | 1¼ cu. yds. | —200 hp | BC |

## DELAWARE

**Hydromar Corp., 100 West 10th Street, Wilmington, 19801.**

| | | | |
|---|---|---|---|
| "Hydro Atlantic" | | 8,000 hp | |

## FLORIDA

**Capeletti Bros., Inc., P.O. Box 4944, Hialeah, 33014**

| | | | |
|---|---|---|---|
| "Wanda C" | 12 in. | 375 hp | CS |
| "Kelly L" | 16 in. | 1,200 hp | CS |

Capeletti Bros., Inc. was organized in 1954 and has grown from a small one truck operation to one of the largest heavy construction contractors in the South Florida area, specializing in road building, construction of major bridges, storm drainage and sanitary sewers and water distribution systems.

The principal company officials are as follows:
A.J. Capeletti—president;
C.L. Capeletti—executive vice president;
W.R. Greenwall—secretary;
O.L. Kitchens—treasurer;
E.I. Espino, P.E.—general superintendent.

**E.I. DuPont de Nemours & Co., Inc., P.O. Drawer A, Lawtey, 32058**

| | | | |
|---|---|---|---|
| "No. 1" | 20 in. | 1,300 hp | CS |
| "No. 2" | 20 in. | 1,150 hp | CS |

**Hendry Corporation., P.O. Box 13228, 5107 South Westshore Blvd., Tampa, FL 33681**

| | | | |
|---|---|---|---|
| "No. 4" | 24 in. | 4,000 hp | CS |
| "No. 5" | 24 in. | 4,000 hp | CS |
| "No. 6" | 18 in. | 1,800 hp | CS |
| "No. 19" | 3 cu. yds. | | BC |
| "No. 21" | 4 cu. yds. | | BC |
| "No. 27" | 5 cu. yds. | | BC |
| "No. 37" | | 100 ton floating crane | |

The Hendry Corporation was founded in 1926, and is engaged in dredging in South and Central America, the Caribbean, the Gulf and Atlantic Coast. Hendry Corporation owns and operates a 25 acre shipyard with a 1,000 ton floating drydock and complete machine shop in Tampa, Florida. This facility is also used for steel fabrication and new construction of floating equipment. Tugs and Salvage, Inc. is a wholly-owned subsidiary of Hendry Corporation engaged in towing and the recovery of sunken equipment. Mechanical and civil engineering services are also available.

Management personnel are:
A.W. Hendry—president;
F.J. Howard—vice president & treasurer;
W.S. Humphreys, Jr.—vice president, operations;
L.F. Kinzly—vice president;
D.G. Wilkinson—shipyard terminal manager.

**Alfred H. Inman, Jr., Inc., 5 Interlaken Road, Orlando, 32804, Tel.: CY3-5931**

| | | | |
|---|---|---|---|
| "Floridian" | 12 in. | — | CS |

**Layne Dredging Co., 2500 E. Beach Blvd., Hallandale, 33009**

| | | | |
|---|---|---|---|
| "Robert M. Cason" | 20 in. | 3,200 hp | CS |
| "H.B. Layne" | 20 in. | 2,500 hp | CS |
| "Michael L." | 16 in. | 2,000 hp | CS |
| "Miss Golden Isles" | 12 in. | 1,000 hp | CS |
| "Kings Bay" | 12 in. | 1,000 hp | CS |

**Parkhill-Goodloe Co., Inc., P.O. Box 8707, 5137 Arlington Road, Jacksonville, 32211**

| | | | |
|---|---|---|---|
| "Florida" | 18 in. | 3,600 hp | CS |
| "Dauntless" | 18 in. | 2,600 hp | CS |
| "XL" | 18 in. | 1,500 hp | CS |
| "Palm Coast" | 10 in. | 350 hp | CS |

**Pillsbury Dredging Co., Inc., 1512 53rd Avenue West, Palmetto, 33561**

| | | | |
|---|---|---|---|
| "Sand Piper" | 12 in. | 1,250 hp | CS |
| "Our No. 1" | 8 in. | 450 hp | CS |

**Prosperity Dredging Co., Inc., Box 12425, Lake Park, 33403**

| | | | |
|---|---|---|---|
| "Palm Beach" | 14 in. | 600 hp | CS |
| "Juno" | 12 in. | 560 hp | CS |
| "Lake Park" | 10 in. | 400 hp | S |
| "Jupiter" | 2 cu. yds. | | BC |

**St. George Island Gulf Beaches, Inc., P.O. Box 629, Tallahassee, 32302**

| | | | |
|---|---|---|---|
| "No. 1" | 10 in. | | CS |

**Trans-State Dredging Co., Box 3426, Fort Pierce, 33450**

| | | | |
|---|---|---|---|
| "Stuart" | 19 in. | 3,200 hp | C |

Management personnel are:
Karl Bauer—president;
W.B.—Pearce, vice president;
Roger Lovett—project superintendent.

## GEORGIA

**Latex Construction Co., 4959 New Peachtree Road, Atlanta, 30340**

| | | |
|---|---|---|
| "Natchez" | 20 in. | CS/M |
| "Audrine" | 12 in. | CS/M |

## IDAHO

**Kloepfer Inc., Box 87, Paul, 83347**

| | | |
|---|---|---|
| "No. 1" | 8 in. | S/M |

## ILLINOIS

**Allendale Gravel Co., R.F.D. No. 1, Allendale, 62410**

| | | |
|---|---|---|
| "Thomas HL" | 10 in. | S/M |

**DunBar Sand & Gravel Co., Box 97, Bellmont, 62811**

| | | |
|---|---|---|
| "No. 1" | 8 in. | S/M |

**Great Lakes International Inc., 2122 York Rd., Oak Brook, 60521**

| | | |
|---|---|---|
| "California" | 30 in. | CS |
| "Illinois" | 27 in. | CS |
| "Alaska" | 27 in. | CS |
| "New York" | 27 in. | CS |
| "Georgia" | 26 in. | CS |
| "Louisiana" | 25 in. | CS |
| "Puerto Rico" | 24 in. | CS |
| "Rhode Island" | 14 in. | CS |
| "Crest" | 12 cu. yds. | BD |
| "Boston" | 10 cu. yds. | BD |
| "Mogul" | 12 cu. yds. | BD |
| "No. 51" | 9-15 cu. yds. | BC |
| "No. 52" | 10-21 cu. yds. | BC |
| "No. 53" | 10-21 cu. yds. | BC |
| "No. 54" | 10-21 cu. yds. | BC |
| "No. 57" | 10-12 cu. yds. | BC |
| "Conical" | 6-12 cu. yds. | BC |
| "No. 50" | 6-14 cu. yds. | BC |
| "No. 55" | 5-12 cu. yds. | BC |
| "No. 56" | 5-12 cu. yds. | BC |
| "No. 811" | 4-6 cu. yds. | BC |

Great Lakes International Inc. (GLI) was created in 1979 as the parent of Great Lakes Dredge & Dock Co. (GLD&D) and its subsidiaries. The original company was formed in 1890 and incorporated in 1905. The company is engaged in dredging operations on all coastal and many inland waters of the United States. The Company's primary customers are governmental agencies, both domestic and foreign.

Recent projects are underway or have recently been completed in Argentina, Colombia, Canada, Kenya and the United Arab Emirates.

In addition to dredging, the company performs other types of marine construction work, such as subaqueous pipelines, dock building, subaqueous rock drilling and removal, breakwaters, bridge sub-structures, beach nourishment and land reclamation.

Offices are maintained in Union, New Jersey; Staten Island, New York; Towson, Maryland; Tampa, Florida; New Orleans and Morgan City, Louisiana, and Oakland, California, in addition to corporate headquarters in Oak Brook, Illinois.

North American Trailing Co., a subsidiary of GLD&D, with the participation of Amsterdam Ballast Dredging of Amstelveen, The Netherlands, does hopper dredging in the US.

GLI is listed on the New York Stock Exchange (GL).

John A. Downs—chairman of the board;
William L. Colnon—president and chief executive officer.

**GLI Subsidiary, Henry Dubois**

| | | |
|---|---|---|
| "Long Island" | 16,000 cu. yds. | TH |

**GLD&D Subsidiary, North American Trailing Company, 2122 York Road, Oak Brook**

| | | | |
|---|---|---|---|
| "Padre Island" | 24 in. | 8,200 hp | TH |
| "Manhattan Island" | 24 in. | 8,200 hp | TH |
| "Sugar Island" | 24 in. | 10,800 hp | TH |
| "Dodge Island" | 24 in. | 10,800 hp | TH |
| "Northerly Island" | 18 in. | 8,595 hp | TH |

**Lawder Sand Co., Box 76, Gorham, 62940**

| | | |
|---|---|---|
| "No. 1" | 10 in. | S/M |

**Luhr Bros. Inc., P.O. Box 69, 1020 No. Main St., Columbia, 62236**

| | | | |
|---|---|---|---|
| "Elco" | 24 in. | 2,800 hp | CS/M |

**McKenzie Dredging Co., Inc., Box 866, Galesburg 61401**

| | | | |
|---|---|---|---|
| "Beaver" | 14 in. | 900 hp | CS |
| "No. 781" | 1½ cu. yds. | | BC |
| "Iowa" | 1½ cu. yds. | | BC |

**Southern Illinois Sand Co., Inc., 1200 Swanwick, Chester, 62233**

| | | | |
|---|---|---|---|
| "No. 3" | 10 in. | 550 hp | S |
| "No. 5" | 10 in. | 500 hp | CS |

This company was incorporated in 1946. It now has harbor services at several locations, in addition to sand operations at two locations.

Company officials are:
S.F. Brown;
A.S. Lawder;
B.W. Brown.

## INDIANA

**Irving Ready-Mix, Inc., 13415 Coldwater Rd., Ft. Wayne, 46825**

| | | | |
|---|---|---|---|
| "No. 1" | 8 in. | 400 hp | CS/M |

**Knox County Sand Co., P.O. Box 943, Vincennes, 47591**

| | | |
|---|---|---|
| "No. 1" | 10 in. | S/M |

**Lafayette Waterworks, 20 North 6th Street, Lafayette, 47901**

| | | |
|---|---|---|
| "No. 1" | 8 in. | S/M |

## IOWA

**Acme Fuel & Material Co., Box 34, RR #5, Muscatine, 52761**

| | | | |
|---|---|---|---|
| "Lady Margaret" | 10 in. | 300 hp | S/M |
| "No. 3" | 10 in. | 300 hp | S/M |
| "No. 4" | 8 in. | 250 hp | CS/M |
| "No. 1" | 12 in. | 350 hp | S/M |
| "Miss Julie" | 10 in. | 300 hp | CS/M |

**Coots Materials Co., Box 90, Mt. Auburn, 52313**

| | | | |
|---|---|---|---|
| "Custom" | 8 in. | 335 hp | S/M |

**Determann River Terminal, Inc. 1425 Washington Blvd., Camanche, 57230**

| | | |
|---|---|---|
| "No. 1" | 8 in. | CS |

**Molo Sand & Gravel Co., 41 Main St., Dubuque, 52001**

| | | |
|---|---|---|
| "No. 1" | 10 in. | CS |

The Molo Sand & Gravel Company was established in 1913 and sells products pertaining to construction work.

Company officials are:
Robert E. Molo—president;
Robert J. Oppenheimer—vice president;
Justin R. Driscoll—corporate secretary;
Helen T. Molo—treasurer.

**West Des Moines Sand Co., Box 98, West Des Moines, 50265**

| | | |
|---|---|---|
| "No. 1" | 10 in. | CS/M |

**Western Contracting Corp., 400 Benson Bldg., Sioux City, 51101**

| | | | |
|---|---|---|---|
| "Western Condor" | 42 in. gas turbine | 30,000 hp | CS |
| "Western Chief" | 30 in. | 13,000 hp | CS |

Hydraulic dredging is one of Western's major areas of construction using powerful, modern cutter suction

dredges that have capabilities for dredging deep, hard materials in open waters. For over 30 years, Western has dredged a wide range of materials, from soft river silts to hard coral rock, not only in the United States, but also in the offshore harbors and channels in the Caribbean, South America, Africa, Asia, Australia and Pacific Ocean Islands.

Company officials are:
L. Garland Everist—chairman of the board;
Daniel Everist—president;
Alfredo M. Perez—vice president;
James L. Nutt—chief engineer.

## KANSAS

**Barton County Highway Dept., Box 46, Great Bend, 67530**

| | | | |
|---|---|---|---|
| "No. 900" | 8 in. | 400 hp | CS/M |
| "No. 901" | 8 in. | 400 hp | S/M |
| "No. 903" | 8 in. | 400 hp | S/M |

**Builders Sand Co., 4150 Kansas Avenue, Kansas City, 66106.**

| | | | |
|---|---|---|---|
| "No. 1" | 10 in. | 500 hp | CS/M |
| "No. 2" | 10 in. | 500 hp | CS/M |
| "No. 3" | 8 in. | 350 hp | CS/M |
| "Victory" | 10 in. | 350 hp | CS/M |

**Holliday Sand & Gravel Co., P.O. Box 2903, 6811 W. 63rd St., Overland Park, 66202**

| | | | |
|---|---|---|---|
| "Randolph" | 18 in. | 2,000 hp | CS/M |
| "St. Joseph" | 12 in. | 500 hp | CS/M |
| "Edwardsville" | 12 in. | 500 hp | CS/M |
| "Muncie" | 12 in. | 500 hp | CS/M |
| "Bonner" | 10 in. | 400 hp | CS/M |

This company specializes in sand and gravel production on the Missouri and Kansas Rivers.

Management personnel are:
C.E. Clark—president;
William D. Grinstead—vice president, production;
Charles G. Millsap—production manager.

**Lawrence Sand Co., Div. LRM Industries, Inc., P.O. Box 490, Sixth and Lincoln, Lawrence, 66044**

| | | | |
|---|---|---|---|
| "No. 3" | 10 in. | 300 hp | CS/M |
| "Laura Anne" | 8 in. | 200 hp | CS/M |

Management personnel are:
Travis E. Glass—president;
Stephen E. Glass—vice president;
Clifford Black—superintendent.

**List & Clark Construction Co., P.O. Box 2903, 6811 W. 63rd St., Overland Park, 66201**

| | | | |
|---|---|---|---|
| "Hawthorn" | 18 in. | 1,600 hp | CS |
| "Liberty" | 12 in. | 600 hp | CS |

List & Clark Construction Company engages in contract dredging and construction on the Missouri and Kansas Rivers.

Management personnel are:
Charles Clark—president;
Don Parker—superintendent.

**Miles Sand Co., Inc., 4852 No. Meridian, Wichita, 67204**

| | | |
|---|---|---|
| "No. 1" | 10 in. | CS/M |

## KENTUCKY

**Dunbar & Sullivan Dredging Co., Rivers Division, P.O. Box 66, Eddyville, 42038**
*(See headquarters listing, Ohio)*

**Henderson County Sand Co., Box 735, Henderson, 42420**

| | | |
|---|---|---|
| "No. 1" | 10 in. | S/M |

**Martin Marietta Aggregates, Central Div., Ohio River Dist., Box 35210, Louisville, 40232**

| | | | |
|---|---|---|---|
| "Hel-Del" | 375 cu. yds./hr. | 1,275 hp | BL/M |

**McHugh Corporation, Route 2, Box 128, Louisa, 41230**

| | | | |
|---|---|---|---|
| "Number 1" | 8 in. | 240 hp | S |
| "Number 2" | 8 in. | 100 hp | S |

McHugh Corporation has been in the dredging business since 1945, and has worked all over the country. They now have offices in Florida as well as Kentucky.

Management personnel are:
William R. McHugh—president;
Karl Bachman—vice president;
Judy McHugh—secretary/treasurer.

**Owensboro River Sand & Gravel Co., Inc., Box 2000, 701 E. Second Street, Owensboro, 42301**

| | | |
|---|---|---|
| "W.L. Delker" | 16 in. | S/M |

## LOUISIANA

**Bean Dredging Corporation, Heritage Plaza, Suite 1700, P.O. Box 61003, New Orleans, 70161-1003**

| | | | |
|---|---|---|---|
| "Eagle I" | 6,400 cu. yds. | 11,685 hp | TH |
| "Lenel Bean" | 38 in. | 7,300 hp | SD |
| "Jim Bean" | 27 in. | 15,250 hp | CS |
| "Dave Blackburn" | 27 in. | 6,950 hp | CS |
| "BDCO No. 32" | 27 in. | 8,350 hp | CS |
| "Buster Bean" | 27 in. | 7,806 hp | CS |

**C.F. Bean Corporation, P.O. Box 237, Belle Chasse, 70037**

| | | |
|---|---|---|
| Bean No. 2 "Bubba J" | 6.5 cu. yds. | BG |
| Bean No. 4 | 6.5 cu. yds. | BG |
| Bean No. 6 "C.W. Bean" | 8.0 cu. yds. | BG |
| Bean No. 8 | 6.5 cu. yds. | BG |

**General Portland Inc., Drawer 790, Lake Charles, 70802**

| | | |
|---|---|---|
| "No. 1" | 16 in. | S/M |

**Gulf Coast Trailing Company, P.O. Box 10, Kenner, 70063**

| | | | |
|---|---|---|---|
| "Atchafalaya" | 21.7 in.—1 Drag Arm | 2,880 hp | TH |
| "Mermentau" | 17.7 in.—2 Drag Arms | 2,960 hp | TH |
| "Mississippi" | 2,926 cu. m. | 9,040 hp | TH |

Gulf Coast Trailing Company is a partnership of T.L. James & Company, Inc., Ruston, La., and the Dutch company, Hollandsche Aanneming Maatschappij (HAM), and the Belgian company, Dredging International.

The hopper dredges "Atchafalaya" and the "Mermentau" were built by Twin City Shipyard, Inc., St. Paul, Minnesota—the former having been operating since October, 1980, and the latter since February of 1982.

Gulf Coast Trailing Co. has contracted with Twin City Shipyard for a third hopper dredge, to be named "Ouachita", with a capacity of 3,850 cu. yds. Delivery is scheduled within 24 months.

**Mike Hooks, Incorporated, Box 1525, Lake Charles, 70602**

| | | |
|---|---|---|
| "Galveston" | 24 in. | CS |
| "Louisiana" | 27 in. | CS |
| "E. Stroud" | 24 in. | CS |
| "Gayle" | 20 in. | CS |
| "Missouri H" | 27 in. | CS |
| "No. 3000" | 3 cu. yds. | BC |
| "No. 3900" | 4 cu. yds. | BC |
| "No. 4000" | 4 cu. yds. | BC |

**T.L. James & Company, Inc., P.O. Box O, Ruston, 71270**
**Dredging Division: P.O. Box 826, Kenner, 70063**

| | | | |
|---|---|---|---|
| "Bill James" | 30 in. | 7,200 hp | CS |
| "Capt. Clark" | 30 in. | 6,000 hp | CS |
| "Tom James" | 30 in. | 6,135 hp | CS |
| "Geo. D. Williams" | 20 in. | 4,000 hp | CS |
| "BTD-51" | 20 in. | 2,750 hp | CS |
| "BTD-2" | 20 in. | 1,750 hp | S |
| "Armadillo II" | 20 in. | 2,112 hp | CS |
| "Lewis James" | 20 in. | 1,600 hp | CS |
| "BT-10" | 7 cu. yds. | | BC |

| | | | |
|---|---|---|---|
| "Atlas No. 1" | 6 cu. yds. | | BC |

Company officials are:
G.W. James, Jr.—president;
George D. Williams, Sr.—vice president;
L.P. Mathews—vice president;
Gary Gibbs—general superintendent.

**Kenner Marine & Machinery, Inc., P.O. Box 1200, Laplace, 70068**

| | | | |
|---|---|---|---|
| "New Orleans" | 24 in. | 2,800 hp | CS |
| "Riverlands" | 16 in. | 1,900 hp | CS |
| "Miken" | 16 in. | 2,100 hp | CS |
| "Islander" | 14 in. | 1,125 hp | CS |
| "Chattanooga" | 14 in. | 1,000 hp | CS |
| "Venture" | 14 in. | 1,125 hp | CS |
| "SD-110" | 12 in. | 600 hp | CS |
| "Harriett" | 10 in. | 400 hp | CS |
| "Mardi Gras" | 10 in. | 450 hp | CS |
| "Billy Goat II" | 10 in. | 350 hp | CS |
| "Billy Goat I" | 8 in. | 275 hp | CS |
| "Alabama" | 8 in. | 470 hp | CS |
| "Pipeliner" | 12 in. | 1,220 hp | S |

This company was founded in 1971 for the purpose of designing, constructing and operating dredging equipment. They have had a steady growth pattern and presently employ approximately 125 employees.

Company officials are:
Thomas J. Wetta, III—president;
Wilbert A. Rodriguez—vice president;
John Crabtree, Jr.—chief engineer and naval architect;
Reginald Savoie—business manager.

**McDermott Incorporated, P.O. Drawer 38, Harvey, 70059**

| | | | |
|---|---|---|---|
| "Ralph T." | 10 cu. yds. | | BC/BG |
| "Cocodrie" | 8 cu. yds. | | BC/BG |
| "C.A. Beason" | 8 cu. yds. | | BC/BG |
| "Creole" | 8 cu. yds. | | BC/BG |
| "Lafitte" | 8 cu. yds. | | BC/BG |
| "C.B. Dodgen" | 6 cu. yds. | | BC/BG |
| "A.H. Stall" | 10 cu. yds. | | BC/BG |

**P & L Hauling Contrs., Inc., U.S. Hwy. 90, Boutte, 70039**

| | | | |
|---|---|---|---|
| — | 12 in. | | CS |

**Saba Dredging Co., Inc., P.O. Box 363, Westwego, 70094**

| | | | |
|---|---|---|---|
| "Crown Point" | 12 in. | | S |
| "Titan" | 12 in. | | S |

Company officials are:
Norris P. Delatte—president;
Elie Leonard—vice president;
Clifford A. Crane—treasurer;
Clarence J. Delatte—secretary.

**Stuyvesant Dredging Co., 3525 North Causeway Blvd., Suite 612, Metairie, 70002**

| | | | |
|---|---|---|---|
| "Stuyvesant" | 9,200 cu. yds. | 15,000 hp | TH |

**Williams-McWilliams Company, P. O. Box 7730-70010, 3525 N. Causeway Blvd., Metaire, 70002**

| | | | |
|---|---|---|---|
| "Diesel" | 30 in. | 9,044 hp | CS |
| "Fritz Jahncke" | 27 in. | 7,700 hp | CS |
| "Port Arthur" | 24 in. | 4,640 hp | CS |
| "Arkansas" | 24 in. | 4,600 hp | CS |
| "Natchez" | 24 in. | 4,000 hp | CS |
| "Paul F. Jahncke" | 24 in. | 5,500 hp | CS |
| "Pontchartrain" | 24 in. | 5,400 hp | CS |
| "Vicksburg" | 20 in. | 2,475 hp | CS |
| "Manchac" | 20 in. | 3,050 hp | CS |

Founded in 1890 as McWilliams Dredging Co. and later merged with W. Horace Williams Construction Co., Williams-McWilliams Co. was incorporated in 1957.

The company's dredges have worked in all areas of the United States as well as overseas and the dredging experience includes construction of dams and flood control levees, deepening harbors and rivers, reclamation of low land for roads and airports, and maintenance of ship channels. Specialized deep dredging equipment enables the company to hydraulically excavate, with a cutter, from depths 150 feet below the water surface.

Management personnel are:
William L. Rose, Jr.—president;
Carl B. Hakenjos—vice president;
C.S. Benton—vice president;
D.L. Miller—operations manager;
John P. Newman—operations manager.

## MAINE

**Northeast Dredging Co., Inc., P.O. Box 2305, 95 Florence St., South Portland, 04106**

| | | | |
|---|---|---|---|
| "Maliea K" | 12 in. | | CS |

## MARYLAND

**Bloomingdale Construction Co., P.O. Box 15, Queenstown, 21658**

| | | | |
|---|---|---|---|
| "Rosedale" | 12 in. | 550 hp | CS |

**Southern Maryland Dredging, Inc., Woodside Farm, Friendship, A.A. Co. 20758**

| | | | |
|---|---|---|---|
| "Brunswick" | 12 in. | 900 hp | CS |
| "Finney Titus" | 10 in. | 400 hp | CS |

**Standard Dredging Corp., 2 E. Fayette St., Baltimore, 21202**

| | | | |
|---|---|---|---|
| "New Jersey"* | 30 in. | 6,000 hp | CS |
| "Orleans"* | 27 in. | 4,000 hp | CS |
| "Cayman" | 18 in. | 2,000 hp | CS |
| "Cartagena"* | 27 in. | 4,000 hp | CS |

* Operated by wholly owned subsidiary, **Standard Dredging-Mid-East, Inc.**

## MASSACHUSETTS

**Crosby & Scott, Inc., Box 456, Osterville, 02655**

| | | | |
|---|---|---|---|
| "Seapuit" | 10 in. | | CS |

**Fournier Towing & Dredging Co., 134 Ten Hills Rd., Somerville, 02143**

| | | | |
|---|---|---|---|
| "Detroit" | 4 cu. yds. | | BC |

**Hydro-Dredge Corp., P.O. Box ER813, New Bedford, 02742, Tel.: (617) 997-6181**

| | | | |
|---|---|---|---|
| "Smithtown" | 16 in. | 2,500 hp | CS |
| "Sandpiper" | 12 in. | 800 hp | CS |
| "Big Ben" | 8 cu. yds. | — | BC |
| "James E" | 4 cu. yds. | — | BC |
| "Vernon W" | 6 cu. yds. | — | BB |

## MICHIGAN

**Canonie Offshore, Inc., (formerly Bultema Dock & Dredge Co.), 559 E. Western Avenue., P.O. Box 728, Muskegon, 49443**

| | | | |
|---|---|---|---|
| "Wilkinson" | 18 in. | 1,750 hp | CS |
| "Mac Thompson" | 16 in. | 1,000 hp | CS |
| "Engler" | 16 in. | 1,000 hp | CS |
| "Michigan" | 10 cu. yds. | | BG |
| "Virginia" | 10 cu. yds. | | BG |
| "Minnesota" | 10 cu. yds. | | BG |
| "Wisconsin" | 6 cu. yds. | | BG |
| "Illinois" | 8 cu. yds. | | BG |
| "Indiana" | 6 cu. yds. | | BG |

Company officials are:
John R. Parmater—president;
Joseph J. Foorocy—manager engineering;
Donald Olsen—equipment manager;
Peter McGregor—treasurer/assistant secretary.

**Har-Bur Enterprise, Inc., 3860 U.S. 31, St. Joseph, 49085**

| | | | |
|---|---|---|---|
| "No. 1" | 12 in. | | CS |

**Luedtke Engineering Company, P.O. Box 111, Frankfort, 49635**

| | | | |
|---|---|---|---|
| "Kingfisher" | 10 in. | 600 hp | CS |
| "No. 16" | 10 cu. yds. | | BC |
| "No. 14" | 3½ cu. yds. | | BC |
| "No. 12" | 3½ cu. yds. | | BC |
| "No. 10" | 3½ cu. yds. | | BC |
| "Wellston" | 3½ cu. yds. | | BC |
| "No. 11" | 3 cu. yds. | | BB |

Founded in 1930, Luedtke Engineering Company has 50 years of continuous experience in maritime contracting. Does all types of dredging, piledriving, pipeline and other marine construction on the Great Lakes.

Management personnel of Luedtke Engineering Co. are:
Karl E. Luedtke—president;
Erich R. Luedtke—secretary/treasurer;
Thomas N. Zatkovic—general superintendent;
Stephen P. Zachman—chief engineer;
Lee W. Hollenbeck—office manager.

**Mead Brothers Excavating Co., Box 99, Springport, 49284**

| | | | |
|---|---|---|---|
| "M & M" | 12 in. | | CS |

**Parker Construction Co., 7524 Lakeshore Rd., Lexington, 48450**

| | | | |
|---|---|---|---|
| "E.W. Parker" | 8 in. | | CS |

**Shepard Marine Construction, 36900 Lamphier, Mt. Clemens, 48043**

| | | | |
|---|---|---|---|
| "No. 2" | 1¼ cu. yds. | | BC |
| "Harris V" | 3 cu. yds. | | BC |
| "Barge 744" | 2 cu. yds. | | BC |

**Wm. W. Stender, Inc., 1700 Evergreen Dr., Bay City, 48706**

| | | | |
|---|---|---|---|
| "Albert S" | 12 in. | 500 hp | CS |
| "Alabama" | 3½ cu. yds. | | BC |
| "Helen" | 2 cu. yds. | | BC |

## MINNESOTA

**Winona Aggregate Co., Rt. 17, Winona, 55987**

| | | | |
|---|---|---|---|
| "Meckum" | 14 in. | | S/M |

**Zenith Dredge Co., P.O. BOX 6568, Duluth, 55806**

| | | | |
|---|---|---|---|
| "Superior" | 16 in. | | CS |
| "Duluth" | 5 cu. yds. | | BD |
| "Adele" | 2½ cu. yds. | | BC |

Company officials are:
Donald C. MacDonald—chairman of the board;
Howard T. Hageh—president;
L.K. Yetter—vice president;
R.G. Spicer—secretary/treasurer;
Eben S. Spencer—assistant vice president.

## MISSISSIPPI

**Columbus Gravel Co., Box 2227, Columbus, 39701**

| | | | |
|---|---|---|---|
| "No. 2" | 10 in. | | S/M |
| "No. 1" | 8 in. | | S/M |
| "No. 3" | 8 in. | | S/M |

**Greenville Gravel Company, P.O. Box 220, Greenville, 38701**

| | | | |
|---|---|---|---|
| "Jack Adams" | 16 in. | | S/M |
| "Jack Dill" | 16 in. | | S/M |

## MISSOURI

**Cape Girardeau Sand Co., 1350 N. Water St., Cape Girardeau, 63701**

| | | | |
|---|---|---|---|
| "No. 1" | 14 in | | S M |

**Glacial Sand & Gravel Co., Box 36, Old Monroe, 63369**

| | | | |
|---|---|---|---|
| "No. 1" | 8 in. | | CS M |

**Bernard McMenamy Contractor, Inc., 1600 Fair Lane, St. Charles, 63301**

| | | | |
|---|---|---|---|
| "Mc IV" | 24 in. | 2,500 hp | CS |
| "Mc III" | 20 in. | 3,000 hp | CS |
| "St. Charles" | 14 in. | 1,200 hp | CS |

**Missouri Department of Natural Resources, P.O. Box 176, Jefferson City, 65102**

| | | | |
|---|---|---|---|
| "No. 1" | 8 in. | | CS |
| "No. 2" | 14 in. | | CS |

**Potashnick Construction, Inc., P.O. Box 190, Cape Girardeau, 63701**

| | | | |
|---|---|---|---|
| "Hydro-Pacific" | 36 in. | 14,000 hp | CS |

## NEBRASKA

**Einung Sand & Gravel Co., P.O. Box 221, Wisner, 68791**

| | | |
|---|---|---|
| "No. 1" | 10 in. | CS/M |
| "No. 3" | 10 in. | CS/M |
| "No. 2" | 8 in. | CS/M |
| "No. 4" | 8 in. | CS/M |

**Hartford Sand & Gravel Co., Valley, 68064**

| | | |
|---|---|---|
| "No. 5" | 14 x 16 in. | CS/M |
| "No. 6" | 14 x 16 in. | CS/M |
| "No. 8" | 16 x 20 in. | CS/M |

Management personnel of Hartford Sand & Gravel Co. are:
Don Rogert—chairman of the board;
Bill Green—president;
Dell Becker—vice president.

**Reigle Co., Brunswick, 68720**

| | | |
|---|---|---|
| "Tom-Kat" | 8 in. | S/M |

**Vlasak Sand & Gravel Co., 833 Norman, Crete, 68333**

| | | |
|---|---|---|
| "No. 1" | 8-10 in. | S/M |

**West Holt Gravel Co., Atkinson, 68713**

| | | |
|---|---|---|
| "No. 1" | 6 in. | S/M |

**Zieg Sand & Gravel Co., 120 Poplar, York, 68467**

| | | | |
|---|---|---|---|
| "Sandpiper" | 8 in. | 496 hp | CS |

## NEW JERSEY

**American Dredging Company, P.O. Box 190, Delaware Avenue and State Street, Camden, 08101**

| | | |
|---|---|---|
| "ADCO" | 27 in. | CS |
| "American" | 27 in. | CS |
| "Arkansas" | 27 in. | CS |
| "Ozark" | 27 in. | CS |
| "Delaware II" | 20 in. | CS |
| "Maryland" | 16 in. | CS |
| "Erie" | 16 in. | CS |
| "New Jersey II" | 14 in. | CS |
| "Chesapeake II" | 12 in. | CS |
| "Booster No. 1" | 27 in. | BS |
| "Booster No. 2" | 16 in. | BS |
| "Ranger" | 18 cu. yds. | BG BC |
| "Titan" | 18 cu. yds. | BG BC |
| "New York" | 10 cu. yds. | BG BC |
| "Convoy" | 5 cu. yds. | BG BC |
| "Delaware Valley" | 18 cu. yds. | BG BC |
| "President" | .8 cu. yds. | BD |

American Dredging Co. was incorporated under its present name in 1867. The company's chief areas of operations are the Atlantic and Gulf coasts and it has performed work in foreign areas. In addition to dredging, the company's interests include such areas as subaqueous pipelines, subaqueous rock drilling and excavation, marine demolition, breakwaters, beach nourishment and land reclamation.

Executives are:
A. D. Pistilli—president.
Eugene R. Santhin—vice president and chief engineer;
Donald A. Roeder—vice president and chief estimator;

Robert L. Berg—vice president and general superintendent.

**Barnegat Bay Dredging Co., Inc., Box 336, 8101 Bay Terrace, Harvey Cedars, 08040**

| | | | |
|---|---|---|---|
| "Mike Thomas" | 12 in. | 1,300 hp | CS |

Barnegat Bay Dredging was founded in 1930. The company performs hydraulic dredging in the Northeastern United States, mainly for the Federal Government.

Executives are:
Arnold D. Hill—president;
Virginia A. Hill—vice president;
Claire McHale—assistant secretary;
John Fullerton—general superintendent.

**Gates Construction Corp., 208 Gates Road, Little Ferry, 07643**

| | | | |
|---|---|---|---|
| "Jonathon" | 10 in. | 500 hp | CS |
| "No. 210" | 20 in. | 900 hp | S |
| "No. 302" | 8 cu. yds. | | BB |
| "No. 24" | 6 cu. yds. | | BC |
| "No. 196" | 10 cu. yds. | | BC |

Gates Construction Corp. was incorporated in the State of New Jersey Sept. 15, 1953.

Company officials are:
Robert S. Gates—chairman of the board;
Robert G. Williams—president;
Julian A. Dickinson II—vice president;
Walter Gates—secretary;
Richard W. Marion—treasurer.

**South Jersey Concrete Pipe Co., Inc., P.O. Box 312, Hammonton, 08037**

| | | | |
|---|---|---|---|
| "No. 2" | 12 in. | | CS/M |
| "No. 1" | 8 in. | | CS/M |

**Weeks Dredging & Contracting Inc., 216 North Avenue East, Cranford, 07016**

| | | | |
|---|---|---|---|
| "Weeks Venture" | 24 in. | 6,800 hp | CS |
| "Weeks No. 500" | 15 cu. yds. | | BC |
| "Weeks No. 506" | 15 cu. yds. | | BC |
| "Weeks No. 505" | 10 cu. yds. | | BC |
| "Weeks No. 600" | 6 cu. yds. | | BC |

## NEW YORK

**Concrete Materials, Inc., Box 344, Homer, 13077-0344**

| | | | |
|---|---|---|---|
| "Candy" | 12 in. x 14 in. | 900 hp | CS/M |
| "Booster No. 1" | 12 in. x 14 in. | 500 hp | BS/M |

**Essex Marine Base, Inc., on Lake Champlain, Essex, 12936**

| | | | |
|---|---|---|---|
| "LCjs" | 3/8 cu. yd. | | BC |

**Gibson & Cushman, Inc., 38 Homan Avenue, Bay Shore, 11706**

| | | | |
|---|---|---|---|
| "No. 16" | 20 in. | 4,400 hp | CS |
| "No. 14" | 16 in. | 2,000 hp | CS |
| "No. 8" | 16 in. | 1,000 hp | CS |
| "Shinnecock" | 12 in. | 1,200 hp | CS |
| "Scrod II" | 12 in. | 1,200 hp | CS |
| "Tammy" | 8 in. | 240 hp | CS |

**New York State Dept. of Transportation, 1220 Washington Ave., State Campus, Albany, 12232**

| | | | |
|---|---|---|---|
| "No. 4" | 15 in. | 750 hp | CS |
| "No. 3" | 15 in. | 500 hp | CS |
| "No. 5" | 15 in. | 448 hp | CS |
| "No. 1" | 12 in | 175 hp | CS |
| "No. 4" | 1½ cu. yds. | 153 hp | BC |
| "No. 6" | 1½ cu. yds. | 153 hp | BC |
| "No. 13" | 1½ cu. yds. | 105 hp | BC |
| "No. 8" | 1¼ cu. yds. | 100 hp | BC |
| "No. 1" | 1¼ cu. yds. | 75 hp | BC |
| "No. 2" | 1¼ cu. yds. | 80 hp | BC |
| "No. 2A" | 1¼ cu. yds. | 1 | O hp |
| | | | BC |
| "Wards Island" | 1 cu. yd. | 500 hp | BC |
| "No. 3" | 3¼ cu. yds. | 175 hp | BD |
| "Gradall No.1" | 1¼ cu. yds. | 200 hp | BB |
| "Gradall No. 2" | 1¼ cu. yds. | 200 hp | BB |
| "Gradall No.4" | 1¼ cu. yds. | 200 hp | BB |

## NORTH CAROLINA

**Gilbert Dredging Co., 509 W. Ehringhaus St., Elizabeth City, 27909**

| | | | |
|---|---|---|---|
| "Beaver" | 12 in. | | CS |
| "Mink" | 8 in. | | S |

**North Carolina Dept. of Trans., Mann's Harbor, 27953**

| | | | |
|---|---|---|---|
| "Carolina" | 12 in. | 1,350 hp | CS |
| "Buxton II" | 10 in. | 850 hp | CS |

## OHIO

**Ajax Company, Marine Bldg., 1284 Miller Rd., Avon, 44011**

| | | | |
|---|---|---|---|
| 7,13.6,17.6,20 | | | |
| "Carterett" | 800 tons | | TH |
| "Great Lakes" | 14 in. | | CS |
| "Amy A" | 16 in. | | CS |
| "Four Sons" | 12 in. | | CS |
| "Erie" | 8 in. | | CS |
| "Ajax Challenger" | 5 cu. yds. | | BC |

**Roger J. Au & Son, Inc., Box 1488, Mansfield, 44901**

| | | | |
|---|---|---|---|
| "Esperance III" | 4,000 cu. yds. | 1,950 hp | TH |
| "Michele" | 14 in. | 850 hp | CS |
| "Western Brave" | 5 cu. yds. | | BB |

Roger J. Au & Son, Inc. provides a wide range of construction services in addition to its dredging and marine operations. Services offered for private and public projects throughout the U.S. and overseas involve site development, sewer and water, heavy civil and foundation construction.

C.H. Au—president;
John F. Winter—executive vice president;
Roger C. Au—vice president, underground construction;
Bob Smith—equipment manager.

**C. de Co. Maritime Construction, P.O. Box 1488, Mansfield, 44901.**

| | | | |
|---|---|---|---|
| "Esperance III" | 2800 | 1,800 hp | TH |

**Dunbar & Sullivan Dredging Co., Marine Construction Division, P.O. Box 538, Edgewater Branch, Cleveland, 44107**

**Eddyville, Kentucky Division**

| | | | |
|---|---|---|---|
| "Alabama" | 22 in. | | CS |
| "Niagara" | 22 in. | | CS |
| "P.O.B." | 16 in. | | CS |
| "Dunbar II" | 14 cu. yds. | | BC |
| "Gotham" | 6 cu. yds. | | BC |
| "Ojibway" | 5 cu. yds. | | BC |
| "No. 4" | 4½ cu. yds. | | BC |
| "No. 5" | 3 cu. yds. | | BC |
| "Sullivan" | 10 cu. yds. | | BD |
| "Omadhoun" | 9½ cu. yds. | | BD |
| "Empire" | 7 cu. yds. | | BD |
| "Dunbar I" | 3 cu. yds. | | BB |
| "Iroquois" | 3 cu. yds. | | BC |
| "No. 968" | 2 cu. yds. | | BC |
| "No. 969" | 2 cu. yds. | | BC |
| "Cherokee" | 3 cu. yds. | | BC |
| "Handy Andy" | 6 cu. yds. | | BC |
| "Comanche" | 2 cu. yds. | | BC |

Executives are as follows:
R.E. Johnson—president;
L.E. Lamourie—vice president;
E.J. Davis—secretary/treasurer.

**Grant Contracting Company, Drawer 160, Greenville,**

**45331**

| | | | |
|---|---|---|---|
| "America" | 22 in. | 3,200 hp | CS |
| "Columbus" | 18 in. | 2,250 hp | CS |

Grant Contracting Company does dredging jobs on the Mississippi, Ohio and Illinois Rivers.

W.I. Thieme—chairman;
William E. Hole, Jr.—president;
J.L. Unland—vice president & general manager.

**Soocker Sand & Gravel Co., Box 176, Gnadenhutten, 44629**

| | | |
|---|---|---|
| "Gravel Gerties" | — | CS/M |
| "No. 2" | 12 in. | CS/M |

## OKLAHOMA

**Mohawk Rock & Sand Co., P.O. Box 640, Sand Springs, 74063**

| | | |
|---|---|---|
| "No. 1" | 150 cu. yds. | SH/M |
| "No. 2" | 150 cu. yds. | SH/M |
| "No. 3" | 150 cu. yds. | SH/M |
| "No. 4" | 60 cu. yds. | SH/M |

**Oklahoma Dredging Co., P.O. Box 10, Poteau, 74953**

| | | | |
|---|---|---|---|
| "Oklahoma" | 16 in. | 1,480 hp | CS |

**Yahola Sand & Gravel Co., Box 1401, Muskogee, 74401 (Div. of Arkhola S & G Co., Ft. Smith, Ark.)**

| | | |
|---|---|---|
| "Yahhola No. 1" | 8 in. | CS/M |

## OREGON

**General Construction Co., P.O. Box 03050, Portland, 97203**
*(See Washington listing).*

**Island Construction & Engineering Co., Suite 440, 12200 N. Jantzen Avenue, Portland, 97217**

| | | | |
|---|---|---|---|
| "Dragg'n Lady" | 14 in. | 1,000 hp | CS |
| "Poppen Islander" | 8 in. | 475 hp | CS |

Island Construction & Engineering Co., Division of Hayden Corporation, is a general contractor active in building, heavy and marine construction.

Dirk Koopman—president.

**Nehalem River Dredging, 35800 12th St., P.O. Box 151, Nehalem, 97131**

| | | | |
|---|---|---|---|
| "Nehalem" | 8 in. | 685 hp | CS |
| "Karen" | 8 in. | 300 hp | CS |

Family owned and operated company formed in 1963.

Dredges normally perform maintenance dredging on boat channels and harbors as well as lake reclamation projects.

Company officials are:
Vern Scovell—owner/superintendent;
Lindy Scovell—assistant superintendent;
David DeVault—assistant superintendent.

**Palmberg Construction Co., 311 S.E. Galena, Warrenton, 97146**

| | | | |
|---|---|---|---|
| "Hydro" | 12 in. | 450 hp | CS |
| "Mole" | 12 in. | 450 hp | CS |

Palmberg Construction Co. dredges, portable or seagoing, have been used since 1947 under bare-rental or fully-operated terms on rentals, leases, rental-purchases or contracts, operating on the West Coast, in Alaska, and in Hawaii.

Principal officers of the company are:
H.G. Palmberg—president;
D.E. Palmberg—vice president.

**The Port of Portland, Box 3529, Portland, 97208**

| | | | |
|---|---|---|---|
| "Oregon" | 30 in. | 8,950 hp | CS |

Port of Portland was created in 1891. Its stated purpose was to open a channel for maritime commerce between Portland and the sea. Though many other responsibilities have been added over the years, and the job of channel maintenance now rests with the Corps of Engineers, current statutes require the Port of Portland to provide the Corps of Engineers with a dredge for yearly channel maintenance. For these efforts the Port of Portland is reimbursed only for the cost of operation.

Port officials are:
Lloyd Andersen—executive director;
James Church—deputy executive director;
Dave Neset—director, Marine Services Dept.;
Lawrence Patella—manager, Dredge Division;
Frank Cornelison—chief engineer;
Gerald Yungeberg—dredge captain.

**Western-Pacific Dredging Co., a Division of Riedel International, Inc., P.O. Box 3320, 4555 N. Channel Avenue, Portland, 97208**

| | | | |
|---|---|---|---|
| "Super Dredge" | 30 in. | 7,000 hp | CS |
| "Papoose" | 30 in. | 7,000 hp | CS |
| "Ollie Riedel" | 27 in. | 6,000 hp | CS |
| "H.D. McCurdy" | 30 in. | 6,000 hp | CS |
| "John Franks" | 26 in. | 5,000 hp | CS |
| "R. W. 'Bob' Lofgren" | 26 in. | 5,000 hp | CS |
| "Multnomah" | 24 in. | 4,000 hp | CS |
| "Missouri" | 24 in. | 4,000 hp | CS |
| "Wahkaikum" | 24 in. | 4,000 hp | CS |
| "Art Riedel, Sr." | 20 in. | 2,500 hp | CS |
| "Natoma" | 20 in. | 2,500 hp | CS |
| "Herb Andersen" | 20 in. | 2,500 hp | CS |
| "James H. Polhemus" | 18 in. | 2,000 hp | CS |
| "Sandstorm 2" | 16 in. | 1,500 hp | CS |
| "Mr. Gus" | 16 in. | 1,200 hp | CS |
| "Dakota Nomad" | 16 in. | 1,200 hp | CS |
| "Sandstorm 1" | 10 in. | 600 hp | CS |
| "Big Digger" | 10 cu. yds. | | BC |
| "Green Giant" | 6 cu. yds. | | BC |
| "Paul Bunyan" | 5 cu. yds. | | BC |
| "Skookum" | 5 cu. yds. | | BC |
| "Alligator" | 5 cu. yds. | | BG/BC |
| "Hercules" | 5 cu. yds. | | BC |
| "D.B. Atlas" | 5 cu. yds. | | BC |
| "Rockhound" | 4 cu. yds. | | BC |
| "Goliath" | 4 cu. yds. | | BC |
| "Samson" | 4 cu. yds. | | BC |
| "Titan" | 4 cu. yds. | | BC |
| "Vulcan" | 4 cu. yds. | | BC |
| "Zeus" | 4 cu. yds. | | BC |
| "D.B. Amazon" | 3 cu. yds. | | BC |
| "Columbia" | 2½ cu. yds. | | BC |
| "Ajax" | 2½ cu. yds. | | BC |

## PENNSYLVANIA

**Crain Bros., Inc., Mulberry St. Ext., West Bridgewater, 15009, Tel.: (412) 766-5880**

| | | |
|---|---|---|
| "No. 5" | 4 cu. yds. | BC |
| "No. 3" | 2½ cu. yds. | BC |
| "No. 4" | 2½ cu. yds. | BC |
| "No. 8" | 2½ cu. yds. | BC |
| "No. 9" | 2½ cu. yds. | BC |
| "No. 1" | 4 cu. yds. | BC |
| "No. 6" | 4 cu. yds. | BC |

Crain Bros., Inc. has been in the marine business for over forty (40) years operating on the Inland Waterway System. Dredging, marine construction, marine vessel repairing, and marine transportation are its principal activities.

Principal company officers are:
A. Larry Crain—president;
Richard B. Milsom—executive vice president;

Thomas R. Posey—vice president, construction;
John Fadeley—manager, marine repair;
Kenneth Ray—manager, transportation.

**Dept. of Environmental Resources, State of Pennsylvania, P.O. Box 1467, Harrisburg, 17120**

| | | | |
|---|---|---|---|
| "Clifford L" | 16 in. | 1,065 hp | CS |

**Dravo Corp., Civil, Mining & Marine Div., One Oliver Plaza, Pittsburgh, 15222**

| | | |
|---|---|---|
| "No. 9" | 1½ cu. yds. | BC |
| "No. 10" | 1½ cu. yds. | BC |
| "No. 11" | 1½ cu. yds. | BC |
| "No. 12" | 1½ cu. yds. | BC |
| "No. 13" | 1½ cu. yds. | BC |
| "No. 15" | 1½ cu. yds. | BC |
| "No. 16" | 1½ cu. yds. | BC |
| "No. 17" | 1½ cu. yds. | BC |
| "No. 18" | 1½ cu. yds. | BC |
| "No. 21" | 3-4 cu. yds. | BC |
| "No. 22" | 2½ cu. yds. | BC |
| "No. 23" | 4-7 cu. yds. | BC |
| "No. 24" | 4 cu. yds. | BC |
| "No. 25" | 5-8 cu. yds. | BC |
| "No. 26" | 5-8 cu. yds. | BC |
| "No. 27" | 3½ cu. yds. | BC |

**East Coast Dredging, Inc., P.O. Box 18068,Southwark Station, Philadelphia, 19147**

| | | |
|---|---|---|
| "Jamie" | 14 in. | CS |

**Eastern Seaboard Piledriving, Inc., P.O. Box 18068, Southwark Station, Philadelphia, 19147**

| | | |
|---|---|---|
| "Beverly M" | — | CS |
| "Drag-De-Arena" | — | — |

**Erie Sand & Gravel Company (Erie Sand Steamship Company is a subsidiary), P.O. Box 153, Erie, 16512**

| | | | |
|---|---|---|---|
| M/V "Lakewood" | 20 in. Thomas | 1,600 hp | TS/M |
| M/V "Niagara" | 2-15 in. Morris | 1,200 hp | TS/M |
| M/V "J.S. St. John" | 16 in. Thomas | 560 hp | TS/M |

Company officials are:
Sydney E. Smith, Jr.—president;
Harry K. Goodman—vice president;
Keith L. Branton—marine superintendent.

**M. and O. Marine, Inc., Ohio River at Ohio St., McKees Rocks, 15136**

| | | |
|---|---|---|
| "Kanawha" | 2¼ cu. yds. | BD |
| "Pacific" | 2 cu. yds. | BD |
| "Modco" | 3½ cu. yds. | BC |
| "No. 2" | 3 cu. yds. | BC |
| "Ohio" | 3 cu. yds. | BC |
| "Western" | 3 cu. yds. | BC |
| "Derrick No. 12" | 2½ cu. yds. | BC |
| "Derrick No. 16" | 3 cu. yds. | BC |
| "Eastern" | 3 cu. yds. | BC |

M. and O. Marine, Inc. (formerly Monongahela and Ohio Dredging Co.) was incorporated in 1913. Merged with subsidiary company, Phil & Miller, Inc., Jan. 1, 1978 and changed to present name. Company performs general marine construction on Ohio River and upper Mississippi River systems, pipelines, docks, design and construction, and dredging.

## SOUTH CAROLINA

**Coastal Sand Co., Box 305, Johnsonville, 29555**

| | | |
|---|---|---|
| "Barbara" | 6 in. | S/M |
| "Ann" | 6 in. | S/M |

**Merritt Dredging Company, P.O. Box 31299, Charleston, 29407**

| | | |
|---|---|---|
| "Clinton" | 18 in. | CS |
| "Cherokee" | 18 in. | CS |
| "Junaluska" | 14 in. | CS |
| "Savannah" | 18 in. | CS |

**Salmons Dredging Corp., P.O. Box 42, Charleston, 29402**

| | | |
|---|---|---|
| "Capt. Harry" | 200 T lift | S |
| "Little Boss" | 100 T lift | S |

## TENNESSEE

**Central States Dredging Co., P.O. Box 16806, Memphis, 38116**

| | | |
|---|---|---|
| "Diana G." | 10 in. | S |
| "Sylvia G." | 8 in. | S |

**Dixie Sand & Gravel Co., 515 River St., Chattanooga, 37402**

| | | | |
|---|---|---|---|
| "Walter West" | 12 in. | 1,600 hp | CS |

**Folk Construction Co., Inc., P.O. Box 13428, Memphis, 38113, Tel.: (901) 775-3050**

| | | | |
|---|---|---|---|
| "Cathy M" | 24 in. | 2,875 hp | CS |

## TEXAS

**Deshotel Boat Service, 5046 6th St., Port Arthur, 77640**

| | | |
|---|---|---|
| "Sea Shell" | 12 in. | CS |
| "Keystone" | 12 in. | CS |

**Garrett Construction Co., Box 9257, Corpus Christi, 78408**

| | | |
|---|---|---|
| "Melvin" | 16 in. | CS |

**King Fisher Marine Service AC (512) 552-6751**

| | | | |
|---|---|---|---|
| "J.N. Fisher" | 18 in. | 2,000 hp | CS |
| "Shorty C." | 12 in. | 300 hp | CS |
| "Katrinka II" | 3 cu. yds. | | BG/BC |
| "Barge #22" | 3 cu. yds. | | BG/BC |
| "Leonard M. Fisher" | 20 in. | 2,000 hp | CS |
| "Everett Fisher" | 18 in. | 2,000 hp | CS |
| "Shamrock" | 12 in. | 1,000 hp | CS |
| "Mighty-Mite" | 12 in. | 600 hp | CS |
| "Tyro Jr." | 12 in. | 450 hp | CS |

Formed in 1941 and incorporated in 1959 in the State of Texas. Home base has always been in Port Lavaca, Texas, where a complete repair yard is maintained. The company performs all types of dredging along the Gulf Coast, and is licensed to work in 11 states. Along with dredging, an extensive, well experienced pipeline department is available. The company also has large tug boats and a new drydock that is capable of lifting 2,000 tons. Three of the 12-inch dredges and one of the 18-inch. dredges owned by the company are portable and can be moved overland to places inaccessable by water. Dredging work performed each year is about 50 percent Government, 50 percent private.

Company officers are:
King Fisher—president & chairman of the board;
Waymon Boyd—executive vice president, director;
Warren Herring—vice president, director;
Tim LaQuay—vice president, director;
Ann Boyd—treasurer, director;
Linda LaQuay—secretary, director;
Jewel Fisher—member board of directors.

**Levco Dredging, 2214 S. Hughes St., Amarillo, 79109**

| | | | |
|---|---|---|---|
| "Mudcat I" | 8 in. | 165 hp | Auger |
| "Mudcat II" | 8 in. | 185 hp | Auger |
| "Cutterhead I" | 8 in. | 230 hp | CS |

**Parker Bros & Co., Inc., Box 107, Houston, 77001**

**Loyd W. Richardson Construction Corp., 1054 Rife St., Aransas Pass, 78336**

| | | |
|---|---|---|
| "Tiger" | 15 in. | CS |
| "Loyd W. Richardson" | 12 in. | CS |
| "Archie" | 10 in. | CS |

## VIRGINIA

**Atkinson Dredging Co., P.O. Box 15284, Chesapeake, 23320**

| | | |
|---|---|---|
| "Enterprise" | 18 in. | CS |
| "Hampton Roads" | 18 in. | CS |

| | | | |
|---|---|---|---|
| "Northwood" | 16 in. | | CS |

**Cottrell Engineering Corp., 328 N. Battlefield Blvd., P.O. Box 1907, Chesapeake, 23320**

| | | | |
|---|---|---|---|
| "Richmond" | 12 in. | 1,000 hp | CS |
| "Marion" | 12 in. | 1,000 hp | CS |
| "Blue Ridge" | 12 in. | 700 hp | CS |

**Norfolk Dredging Co., P.O. Box 1706, Chesapeake, 23320**

| | | | |
|---|---|---|---|
| "Pullen" | 22 in. | 5,000 hp | CS |
| "Essex" | 18 in. | 3,200 hp | CS |
| "Talcott" | 18 in. | 2,900 hp | CS |
| "Ft. Pierce" | 16 in. (portable) | 1,450 hp | CS |
| "Jekyll Island" | 14 in. (portable) | 1,150 hp | CS |
| "Hampton" | 12 in. (portable) | 700 hp | CS |
| "Virginian" | 20 cu. yds. | 1,600 hp | BC |
| "428" | 10 cu. yds. | 1,100 hp | BC |
| "998" | 4 cu. yds. | 500 hp | BC |

Norfolk Dredging Company has been engaged in hydraulic and clamshell dredging and related work since 1899. The principal office is located at Virginia, with a branch office and yard located at Stuart, Florida. The major area of work includes the Middle Atlantic and Southeastern coasts.

Guilford D. Ware—president;
Russel J. Thorne—executive vice president;
Lee G. Diton—vice president;
Samual B. Piver—vice president;
Victor H. Bundy—treasurer.

## WASHINGTON

**American Construction Co., Inc., 411-13th St., Everett, 98201**

| | | | |
|---|---|---|---|
| "Mukilteo" | 5 cu. yds. | 700 hp | BC |
| "Palouse" | 5 cu. yds. | 750 hp | BC |
| "Snohomish" | 3 cu. yds. | 550 hp | BC |

**Chris Berg, Inc., 2730 Westlake Avenue, Seattle, 98109**

| | | | |
|---|---|---|---|
| "Super Dragon" | 24 in. | 3,235 hp | CS |

General contractor based in Seattle, Washington with year-round office and shops in Anchorage, Alaska. For over 40 years, has performed throughout the Pacific Rim, from Guam to Alaskan outposts.

Compay officials are:
Norman E. Berg—president;
Kimberly J. Berg—vice president;
James R. Wilcox—executive vice president;
Jack D. Wells—chief engineer.

**Evergreen Tug & Barge Co., Rt. 1, Box 40, Marysville, 98270**

| | | | |
|---|---|---|---|
| "Seacrest No. 1" | 4 in. | 120 hp | CS |
| "Seacrest No. 2" | 1/2 cu. yd. | 120 hp | BC |
| "Palouse" | 5 cu. yds. | 800 hp | BC |

**General Construction Company, 3840 W. Marginal Way, Seattle, 98124**

| | | | |
|---|---|---|---|
| "D.B. Seattle" | 15 cu. yds. | 1,350 hp | BC |
| "The Dalles" | 8 cu. yds. | 450 hp | BC |
| "G. C. 32" | 5 cu. yds. | 450 hp | BC |
| "Frisco" | 4 cu. yds. | 335 hp | BC |
| "Buvvand" | 3 cu. yds. | 250 hp | BC |
| "Beaver" | 3 cu. yds. | 250 hp | BC |
| "G.C. 34" | 3 cu. yds. | 250 hp | BC |
| "H & M" | 3 cu. yds. | 250 hp | BC |
| "Portland" | 3 cu. yds. | 250 hp | BC |

**Hadco Dredging Co., 1429 S. Meridian, Puyallup, 98371**

| | | | |
|---|---|---|---|
| "Hadco No. 1" | 10 in. | | CS |

**Leiter Hockett, Divers & Subaqueous Engineering, 3415 N.W. 66th, Seattle, 98107**

| | | | |
|---|---|---|---|
| "No. 1" | – | | BC |

**Manson Construction Co., 5209 E. Marginal Wy., S., P.O. Box 24067, Seattle, 98124; Tel.: (206) 762-0850**

| | | | |
|---|---|---|---|
| "Newport" | 4,000 cu. yds. | 26 in. | TH |

**Manson-Osberg Co., 1132 No. 128th St., Seattle, 98133**

| | | | |
|---|---|---|---|
| "Husky" | 20 in. | 4,000 hp | CS |
| "Malamute" | 16 in. | 1,500 hp | CS |

**Marine Construction & Dredging, Inc., 1579 Dunbar Road, Mt. Vernon 98273. Tel.: (206) 424-6204**

| | | | |
|---|---|---|---|
| "Super Dragon" | 24 in. | 3,400 hp | CS |
| "Sandpiper" | 10 in. | 600 hp | CS |
| "Shrimp" | 8 in. | 435 hp | CS |

**Port of Bellingham, 625 Cornwall Ave., Bellingham, 98225**

| | | | |
|---|---|---|---|
| "No. 1" | 1½ cu. yds. | | BC/BG |

**Topper Industries Inc., P.O. Box 1568, Vancouver, 98668**

| | | | |
|---|---|---|---|
| "The Hog" | 10 in. | 380 hp | CS |

**Quigg Brothers-McDonald, Inc., P.O. Box 1707, Aberdeen, 98520**

| | | | |
|---|---|---|---|
| "Hoquiam" | 12 in. | 800 hp | S |
| "Melbourne" | 12 in. | 500 hp | S |
| "Muckmaster" | 12 in. | 350 hp | S |
| "Chenalis" | 7 cu. yds. | | BC |
| "Skookum" | 3 cu. yds. | | BC |

**Twin Harbors Dredging Co., P.O. Box 1707, Aberdeen, 98520**

*(See Quigg Brothers-McDonald, Inc.).*

**Western-Pacific Dredging Corp., P.O. Box 3007, Midway, 98301**

**Western-Pacific Dredging Corp., P.O. Box 2160, TriCity, 99302**

*(See Oregon Listing).*

## WEST VIRGINIA

**Ohio River Sand & Gravel, a McDonough Co., P.O. Box 8, Parkersburg, 26101**

| | | | |
|---|---|---|---|
| "Joe Lucas" | 16 in. | 2,000 hp | CS |
| "West Virginia" | 14 in. | 1,300 hp | CS |

## WISCONSIN

**McMullen & Pitz Const. Co., P.O. Box 8, 901 Commercial Street, Manitowoc, 54220**

| | | | |
|---|---|---|---|
| "No. 39" | 2 cu. yds. | | BB |
| "No. 40" | 2 cu. yds. | | BC |
| "No. 46" | 1½ cu. yds. | | BC |
| "No. 64" | 1½ cu. yds. | | BC |

McMullen & Pitz Construction Co. was incorporated in 1918 and has been in business continuously since that time as a heavy, marine and dredging contractor.

Willott A. Pitz—president;
Gerald L. Stoikes—vice president, operations;
Ralph Herzog—general superintendent.

**Robers Dredge, Inc., P.O. Box 484, 816 S. Bainbridge Street, La Crosse, 54601**

| | | | |
|---|---|---|---|
| "Louise" | 16 in. | 2,240 hp | CS |
| "Howard" | 16 in. | 3,500 hp | CS |
| "Dugan" | 12 in. | 1,200 hp | CS |
| "Badger" | 12 in. | 1,070 hp | CS |
| "Marikaye" | 3 cu. yds. | 650 hp | BC |

Robers Dredge, Inc. operates in the Upper Midwest and Northwest portion of the United States.

Company officials are:
Charles E. Robers—president;
Howard G. Robers—general superintendent;
Thomas E. Abraham—assistant general superintendent;
Duane O. Becker—superintendent;
Roy A. Lafser—controller.

## UNITED STATES ARMY CORPS OF ENGINEERS DREDGES

| | Home District | | | |
|---|---|---|---|---|
| "Essayons" | Portland | 6,000 cu. yds. | 7,200 | TH |
| "Wheeler" | New Orleans | 8,400 cu. yds. | 10,400 | TH |
| "Yaquina" | Portland | 825 cu. yds. | 2,250 | TH |
| "McFarland" | Philadelphia | 3,140 cu. yds. | 11,600 | TH |

| | | | | |
|---|---|---|---|---|
| "Schweizer" | Wilmington | 16 in. | 1,150 | S |
| "Merritt" | Wilmington | 12 in. | 1,180 | S |
| "Fry" | Philadelphia | 12 in. | 1,180 | S |
| "Ste. Genevieve" | St. Louis | 20 in. | 2,200 | CS |
| "Dredge No. 6" | Vicksburg | 8 in. | 110 | CS |
| "Henderson" | Omaha | 8 in. | 335 | CS |
| "Dubuque" | Rock Island | 12 in. | 485 | CS |
| "Thompson" | St. Paul | 20 in. | 2,800 | CS |
| "Dillingham" | Alaska | 10 in. | 365 | CS |
| "Warren George" | Alaska | 12 in. | 365 | CS |
| "Luckiamute" | Portland | 12 in. | 750 | CS |
| "Burgess" | Memphis | 32 in. | 4,000 | SD |
| "Potter" | Memphis | 32 in. | 3,050 | SD |
| "Jadwin" | Vicksburg | 32 in. | 4,300 | SD |
| "Gilpin" | Alaska | 3/4 cu. yd. | 131 | BC |
| "Currituck" | — | 315 cu. yds. | 600 | SH |

(*The "Currituck" is a small, shallow draft dredge used in various special purpose applications.)

The U.S. Army Corps of Engineers maintains a fleet of dredges which it uses for maintenance dredging in all navigable waterways of the United States. In addition to performing this dredging itself, the Corps issues permits and awards contracts to private companies for maintenance dredging.

J.K. Bratton—Lieutenant General, U.S. Army, Chief of Engineers;

J.F. Wall—Major General, U.S. Army, Director of Civil Works;

G. Kleb—Colonel, Commander, Water Resources Support Center

W.R. Murden—Chief, Dredging Division.

# APPENDIX B

## LIST OF CONTACTS

## AND

## PERSONAL COMMUNICATIONS

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